TM 11-6680-201-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, FIELD, AND DEPOT MAINTENANCE MANUAL

COUNTER, ELECTRICAL CP-612/GG

HEADQUARTERS, DEPARTMENT OF THE ARMY
12 JANUARY 1962

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 115-volt power supply circuit. Serious injury or death may result from contact with this circuit. Turn off all power to the electrical counter before making any connections or replacing any parts within the equipment.

DON'T TAKE CHANCES!

Technical Manual
No. 11-6680-201-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *12 January 1962*

COUNTER, ELECTRICAL CP-612/GG

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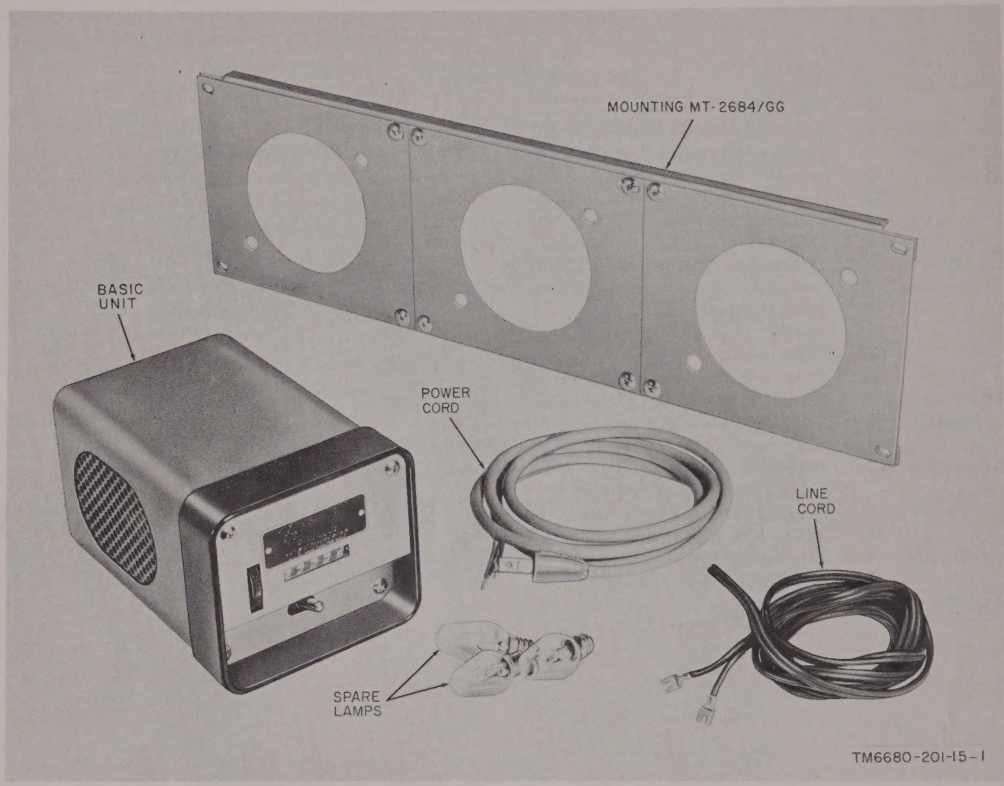

Figure 1. Counter, Electrical CP-612/GG, with Mounting MT-2684/GG.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Counter, Electrical CP-612/GG, and covers the installation, operation, theory, and maintenance. It includes instructions for operation under usual conditions, lubrication, troubleshooting, adjustments, and replacement of parts. Throughout this manual, Counter, Electrical CP-612/GG is referred to as word counter.

2. Forms and Records

a. Unsatisfactory Equipment Reports. Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) as prescribed in AR 700-38.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58.

c. Preventive Maintenance Forms. Prepare DA Form 11-252 (fig. 7 and 8) (Maintenance Check List for Signal Equipment (Teletypewriter)) in accordance with instructions on the form.

d. Parts List Form. Forward DA Form 2028 (Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9) direct to the Commanding Officer, U.S. Army Signal Materiel Support Agency, ATTN: SIGMS-MLM, Fort Monmouth, N. J., with comments on parts listings.

e. Comments on Manual. Forward all other comments on this publication direct to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N. J.

f. Index of Equipment Publications. Refer to DA Pamphlet 310-4 to determine what changes to or revisions of this publication are current.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Counter, Electrical CP-612/GG (fig. 1) counts the number of words transmitted or received on the circuit in which it is installed. The resultant word count (based on an average of six characters per word) is used to determine the need for additional circuits.

b. The word counter may be used on either polar or neutral circuits operating at 60, 75, or 100 words per minute (wpm). The operating speed of the word counter is determined by the intermediate shaft drive gear (speed gear) installed (para 11).

4. Technical Characteristics

Input requirement	105 to 125 volts, 60 cps.
Power consumption	15 watts.
Counting speed:	
With blue (30-tooth) gear.	100 wpm.
With red (40-tooth) gear	75 wpm.
With white (50-tooth gear.	60 wpm.
Counting gear teeth	20.
Average characters per word.	Six.
Maximum count displayed	99,999.
Type of signals	Neutral (20 or 60 ma) or polar.
Motor:	
Type	Induction.
Resistance	33.5 ohms.
Revolutions per minute	3,200 to 3,300 rpm.

Rotation	Clockwise (viewed from the gear end).
Power requirements	105 to 125 volts, 60 cps.
Distortion tolerance:	
Bias distortion	Maximum 40 percent spacing and marking bias.
End distortion	Maximum 40 percent spacing and marking end distortion.
Counter shaft rotation	1/6 revolution per character.
Unit codes	7.42 at 100 and 60 wpm; 7.00 and 7.42 at 75 wpm.
Motor worm	1-tooth involute gear.
Counter worm	2-tooth involute gear.

5. Description (fig. 1)

Counter, Electrical CP-612/GG consists of a basic unit, a line cord, power cord, and three spare lamps (115 volts alternating current (ac), 10 watts).

a. Basic Unit (fig. 6). The basic unit is 3-7/8 inches high, 6-5/8 inches deep, 4-1/2 inches wide, and weighs 4.6 pounds. The internal mechanism of the basic unit is completely enclosed by a removable rear cover and front-panel housing. A power switch protrudes through a hole in the front panel. The five-digit mechanical counter is visible through a window in the front panel. A counter reset knob protrudes through a slot to the left of the counter display window. The internal motor is equipped with a nylon fan to provide air circulation for the word counter through the grills on each side of the rear cover.

b. Cords. Each cord is 6 feet long. The power cord consists of two conductors without terminations at one end. The other end of the power cord is terminated in a two-prong male plug. The line cord also consists of two conductors without terminations at one end. The other end of the line cord is terminated in spade lugs.

6. Additional Equipment Required

Mounting MT-2684/GG (fig. 1) is not supplied as part of Counter, Electrical CP-612/GG, but is required when the word counter is to be mounted in a standard 19-inch rack. Up to three word counters may be mounted in a 19-inch rack using the MT-2684/GG. The MT-2684/GG weighs 1.75 pounds and is 5-1/2 inches high, 1/2 inch deep, and 18-7/8 inches wide.

CHAPTER 2

INSTALLATION AND OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

7. Unpacking

(fig. 2)

a. Packaging Data. When packed for shipment, the basic unit, cords, and spare lamps are packed in a corrugated carton 6-1/2 inches high, 6-3/4 inches wide and 9-3/4 inches deep. Its volume is 430 cubic inches. The packed weight of the word counter is 5.9 pounds.

b. Removing Contents.

Caution: **Be careful when unpacking the equipment. Do not thrust tools into the interior of the shipping cartons because this may damage the equipment.**

(1) Open the cartons by carefully slitting the sealing tape.

(2) Remove the equipment from the cartons.

8. Checking Unpacked Equipment

Check the equipment against the packing list. When no packing list accompanies the equipment, the packaging data (para 7*a*) may be used as a general check to indicate the equipment that *probably* was packed.

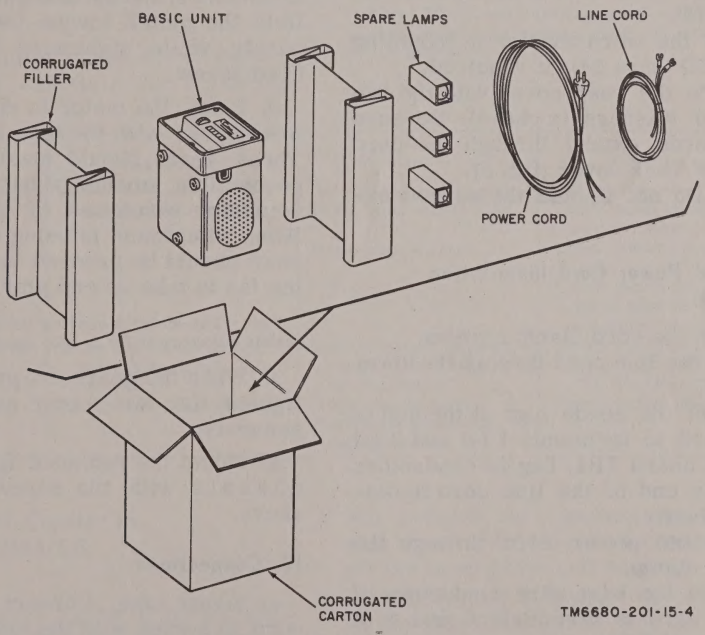

Figure 2. Counter, Electrical CP-612/GG, packaging and packing diagram.

9. General

Note: The tools required for installation are contained in Tool Equipment TE-50-B.

a. Remove the two screws and washers (not shown) that hold the rear cover on the basic unit (fig. 1), and remove the rear cover.

b. Install the line and power cords (para 10) in the basic unit.

c. Change the intermediate shaft drive gear (speed gear), if required (para 11). The word counter is shipped with the 100-wpm gear (blue) installed.

d. Check the lubrication of the friction clutch. Apply 10 to 15 drops of Oil, Lubricating, Felt, Federal stock No. 9150-K60-4299, to each felt washer (fig. 4).

e. Make the connections described in paragraph 12.

f. Test the word counter as described in paragraph 13.

g. Install the word counter in Mounting MT-2684/GG (para 14), if required.

h. Replace the rear cover with the two screws and washers (*a* above). Be sure that the cords extend through the cord cutout in the rear cover (fig. 5).

Caution: Do not tighten the screws excessively.

10. Line and Power Cord Installation (fig. 3)

a. Loosen the cord clamp screws.

b. Insert the line cord through the lower cord clamp.

c. Connect the spade lugs at the end of the line cord to terminals 1 (+) and 2 (-) of terminal board TB1. Tag the conductors at the other end of the line cord to distinguish polarity.

d. Insert the power cord through the upper cord clamp.

e. Connect the bare wire conductors of the power cord to terminals 3 and 4 of terminal board TB1.

f. Tighten the cord clamp screws.

11. Changing Operating Speed (fig. 4)

The red 40-tooth and the white 50-tooth speed gears (for 75- and 60-wpm operation, respectively) are attached to the word counter chassis. Change the speed gear to suit the operating characteristics of the telegraph signal circuit as follows:

a. Loosen the two motor mounting screws and move the motor down so that the motor worm gear is completely disengaged from the installed speed gear.

b. Hold the clutch torque inner locknut securely with an open-end wrench and remove the hexagonal-head screw that secures the speed gear to the gear hub.

c. Remove the screw that secures the proper speed gear to the chassis; remove the proper speed gear.

d. Install the proper speed gear to the gear hub with the large flat washer, the lockwasher, and the hexagonal-head screw. Hold the clutch torque inner locknut securely while tightening the hexagonal-head screw.

e. Raise the motor to engage the motor worm gear with the installed speed gear. These gears should mesh with a barely perceptible amount of backlash through a complete revolution of the speed gear. When adjustment is being made, the motor shaft should be pressed in the direction of the fan to take up end play.

Note: The motor mounting holes are elongated to permit adjustment for proper gear mesh.

f. When the gears are properly meshed, tighten the two motor mounting screws securely.

g. Mount the replaced speed gear to the chassis with the screw removed in *c* above.

12. Connections

a. Signal Line. Connect the signal line cord in series with the signal line so that terminal 1 of terminal board TB1 (fig. 3) is positive (+) and terminal 2 of terminal board TB1 is negative (-) (para 10*c*).

b. Power. Connect the plug on the end of the power cord to a 115-volt, 60 cycle-per-second (cps) ac source.

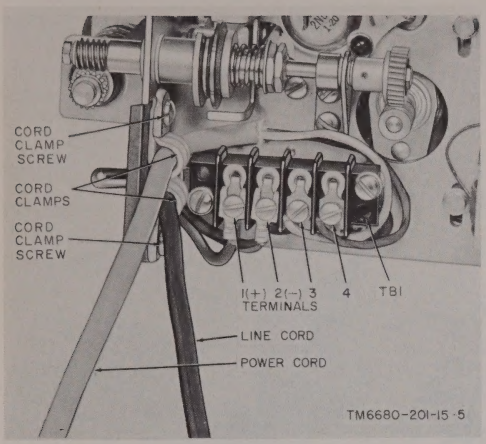

Figure 3. Line and power cord installation in word counter.

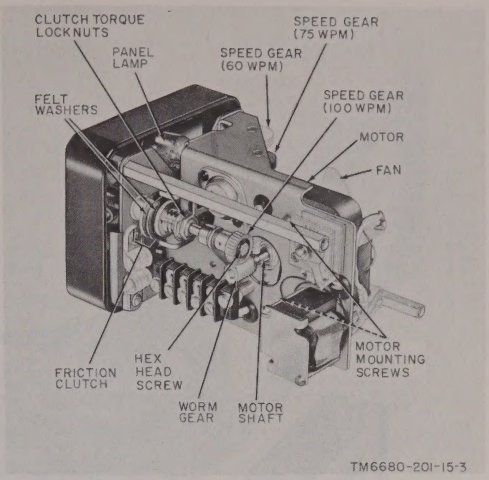

Figure 4. Changing word counter speed gear.

13. Installer's Test

Check the operation of the word counter in the sequence listed in the following chart.

Note: The items listed in the *Corrective measures* column in the following chart are only for the use of the installer.

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	Toggle switch	Operate to *on* (left)	Panel lamp should light. Motor should start.	Check panel lamp (fig. 4) and switch action. Check power source connection. Check motor worm gear and speed gear for binding condition (para 11e).
2	Counter operation.	Send test message over telegraph signal circuit.	Counter should advance one digit for every six characters.	Check signal line connections for proper polarity (para 12). Check friction clutch.
3	Toggle switch	Operate to *off* (right).	Motor should stop. Panel lamp should be extinguished.	Check switch action.

14. Installing Word Counter in Mounting MT-2684/GG (fig. 5)

The MT-2684/GG (para 6) provides spaces for mounting three word counters in a standard 19-inch rack. Install the word counter as follows:

a. Remove the two screws and washers at the rear of the rear cover and remove the rear cover from the word counter.

b. Remove the upper-right and lower-left screws that secure the front plate and housing to the word counter, and lift off the front plate and housing.

c. Carefully assemble the word counter to the MT-2684/GG so that the two tapped hexagonal studs protrude through the 3/8-inch holes. Reinstall the front plate and housing with the two screws (*b* above).

Note: Do not replace the rear cover until the wiring connections have been made, the intermediate shaft drive gear (speed gear) checked and changed, if required, and the friction clutch lubricated (para 9 through 12).

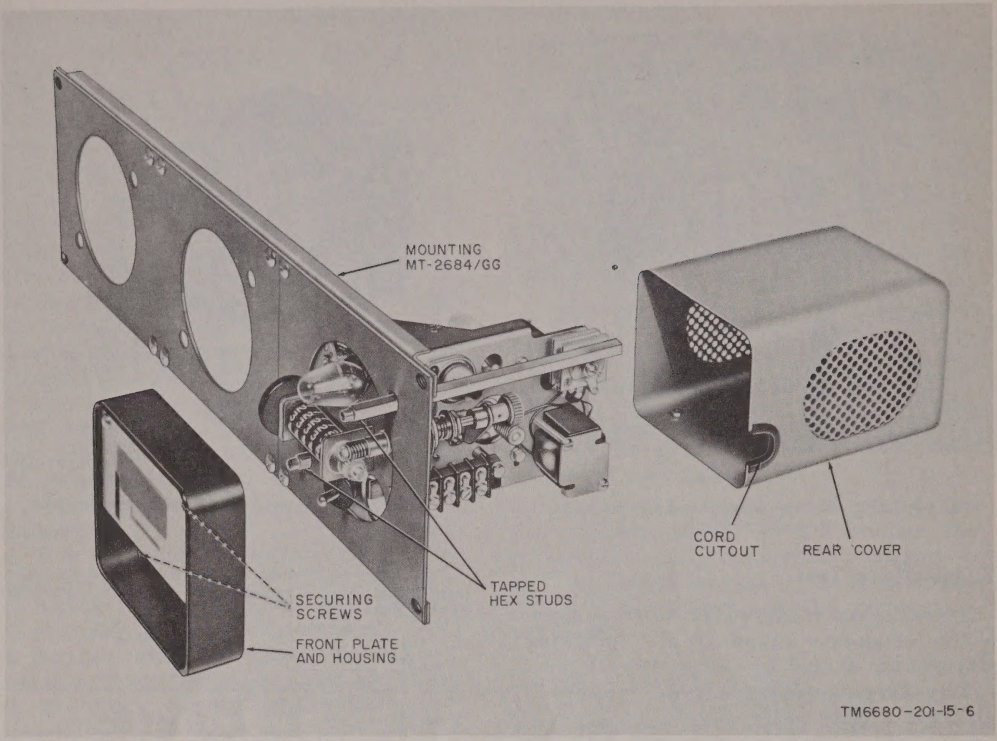

Figure 5. Installing word counter in Mounting MT-2684/GG.

Section III. OPERATION UNDER USUAL CONDITIONS

15. Operator's Controls and Indicator

(fig. 6)

Control or indicator	Description
Power switch	Two-position toggle switch. *Sw pos* — *Function* On (left) — Applies ac power to turn on motor and light panel-illuminating lamp. Off (right) — Disconnects ac power from unit.
Counter reset knob	Mechanically linked to counter display; when rotated, resets counter to zero.
Counter	Five-digit mechanical counter; indicates number of words counted in signal circuit.

16. Operating Procedure

(fig. 6)

a. Starting. Rotate the counter reset knob until the mechanical counter indicates zero (00000). Operate the power switch to *on* (left) to start the word counter.

b. Stopping. Operate the power switch to *off* (right) to stop the word counter.

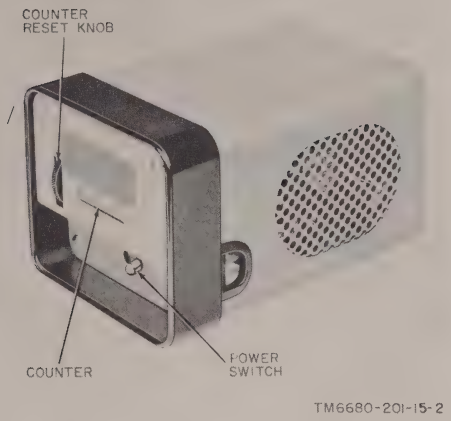

Figure 6. Word counter controls and indicator.

CHAPTER 3

OPERATOR'S MAINTENANCE

17. Scope of Operator's Maintenance

Operator's maintenance consists of those items listed on DA Form 11-252. Solvent, Dry Cleaning (SD), Federal Spec P-S-661a (QMC stock No. 51-S-4385-1) is required to clean the exterior of the word counter.

18. Preventive Maintenance

DA Form 11-252 (fig. 7 and 8) is a preventive maintenance checklist to be used by the operator. Items not applicable to the equipment are lined out in figure 8. Instructions for the use of the form appear on the form.

MAINTENANCE CHECK LIST FOR SIGNAL EQUIPMENT
TELETYPEWRITER
(AR 750-625)

EQUIPMENT NOMENCLATURE

COUNTER, ELECTRICAL CP-612/GG

EQUIPMENT SERIAL NUMBER

131

INSTRUCTIONS

This form may be used for a period of one month by using the correct dates and weeks of the month. It is to be used as a Preventive Maintenance check list for Signal equipment in actual use, or for a check on equipment prior to issue.

1. For detailed Preventive Maintenance instructions see:
   a. The Technical Manual *(in TM 11 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   b. The Supply Bulletin *(SB 11-100 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   c. The Department of the Army Lubrication Order. *(See DA Pamphlet Number 310-4)*

2. The following action will be taken by either the Communications Officer/ Chief for 1st echelon, or the Inspector for higher echelon:
   a. Enter Equipment Nomenclature and Serial Number.
   b. Strike out items that do not apply to the equipment.

3. Operator/Inspector will enter in the columns entitled CONDITION, on the proper line, a notation regarding the condition, using symbols specified under LEGEND.

4. After operator completes each daily inspection he will initial over the appropriate dates under "Daily Condition for Month", then return form to his supervisor.

FOLD

TYPE OF INSPECTION

OPER-ATOR	2/3 ECH-ELON	DATE	SIGNATURE
✓		7 JAN 62	L.L. Lyle
	✓	8 JAN '62	D.E. Count

U. S. GOVERNMENT PRINTING OFFICE: 1957 O—427033

4

DA FORM 1 MAY 57 11-252

REPLACES DA FORMS 11-252, 1 OCT 55; 11-253, 11-262, AND 11-263; WHICH ARE OBSOLETE.

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Figure 7. DA Form 11-252, pages 1 and 4.

LEGEND for marking conditions:
Satisfactory, ✓.
Adjustment, Repair or Replacement required, X.
Defect corrected, (X).

DAILY CONDITION FOR MONTH OF JANUARY 1962

NO.	DAILY ITEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	~~2D~~ 3D ECHELON
		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
1.	CHECK FOR NORMAL OPERATION OF EQUIPMENT. BE ALERT FOR ANY UNUSUAL PERFORMANCE OR CONDITION.	✓	✓	✓	✓	✓	✓	✓										✓
2.	CLEAN DIRT, OIL AND MOISTURE FROM THE EXPOSED SURFACES ~~OF THE TELETYPEWRITER AND COVER.~~	✓	✓	(X)	✓	✓	✓	✓										✓
3.	INSPECT ~~ALL~~ EXTERNAL SWITCHES FOR PROPER MECHANICAL ACTION, FREEDOM OF MOVEMENT AND POSITIVE ACTION.	✓	✓	✓	✓	✓	✓	✓										✓
4.	~~EMPTY CHAD BOXES ON REPERFORATORS AND CHECK BY OPERATION THAT CHAD BOXES ARE FREE OF OBSTRUCTIONS.~~																	

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	~~2D~~ 3D ECH
5. ~~CLEAN THE INSIDE AND OUTSIDE OF TRANSIT CASES. INSPECT FOR BROKEN OR MISSING LATCHES, HANDLES AND EQUIPMENT SUPPORTS OR BRACKETS.~~						
6. INSPECT EXTERNAL ~~CABLES AND~~ CORDS FOR CUTS OR GOUGED JACKETS, FRAYING, BAD BRUISES OR KINKS AND BROKEN PLUGS ~~OR CONNECTORS.~~	✓					✓
7. ~~INSPECT EXTERNAL BINDING POSTS AND TERMINAL BLOCKS FOR CRACKS, BREAKS, DIRT, LOOSE SCREWS, LOOSE CONNECTIONS AND~~ MOUNTINGS.						

ADDITIONAL ITEMS FOR ~~2D AND~~ 3D ECHELON INSPECTIONS	CONDITION
8. ~~INSPECT FOR, AND TIGHTEN, ANY LOOSE SCREWS, NUTS OR BOLTS ON THE COVER OR TRANSIT CASES. CHECK FOR BROKEN CATCHES, LATCHES, HANDLES, HINGES AND MOUNTINGS.~~	
9. INSPECT COVER WINDOWS FOR CRACKS, BREAKAGE, OR OTHER DAMAGE.	✓
10. INSPECT ~~ALL~~ ELECTRICAL PLUGS ~~AND RECEPTACLES~~ FOR BREAKAGE, FIRM SEATING, PROPER CONTACT, CORROSION AND GREASE OR OIL DEPOSITS. CLEAN IF REQUIRED.	✓
11. INSPECT ~~CABLES~~ CORDS AND WIRING FOR CUT OR GOUGED JACKETING, KINKS, BAD BRUISES OR FRAYING.	✓
12. INSPECT ~~BINDING POSTS AND~~ TERMINAL BLOCKS FOR CRACKS, BREAKS, DIRT AND LOOSE CONNECTIONS.	✓
13. INSPECT FOR LOOSE MOUNTING SCREWS AND NUTS ON PARTS OR BRACKETS.	✓
14. INSPECT ~~ALL~~ SWITCHES FOR BINDING, FREEDOM OF MOVEMENT AND POSITIVE ACTION.	✓
15. INSPECT MOTOR ~~AND GOVERNOR FOR WORN BRUSHES AND CONTACTS.~~ CLEAN IF REQUIRED.	✓

ADDITIONAL ITEMS FOR ~~2D AND~~ 3D ECHELON INSPECTIONS	CONDITION
16. ~~CLEAN THE TYPE PALLETS.~~	
17. ~~CLEAN THE KEYTOPS AND CHECK FOR BROKEN, MISSING, LOOSE, OR ILLEGIBLE KEYTOPS.~~	
18. CLEAN INK FEED TUBES AND INK WELLS; REPLACE INKING FELT OR TYPING RIBBON IF REQUIRED.	
19. INSPECT GENERAL CONDITION OF LUBRICATION AND LUBRICATE AS REQUIRED IN ACCORDANCE WITH APPLICABLE LUBRICATION INSTRUCTIONS.	(X)
20. CLEAN EXCESS OIL, GREASE AND DIRT FROM MECHANICAL ASSEMBLAGES, GEARS, SHAFTS, FRAMES, ETC.	✓
21. PERFORM ANY ADJUSTMENT REQUIRED AS A RESULT OF CLEANING, LUBRICATION OR NORMAL WEAR.	(X)
22. INSPECT FOR FREE MOVEMENT OF ALL MOVING PARTS: BENT, BROKEN, DISTORTED OR WORN SHAFTS, GEARS, CAMS, SPRINGS, CLUTCHES, BUSHINGS AND BEARINGS.	✓
23. ~~OPERATE EACH KEY AND CHECK THE FUNCTIONAL RESPONSE.~~	
24. ~~CHECK THAT THE PRINTING ON PAGE PRINTERS IS IN ALIGNMENT HORIZONTALLY AND THAT THE CHARACTERS ARE EVENLY SPACED AND FULLY PRINTED. CHECK THAT THE CHARACTERS ARE FULLY PRINTED ON TYPING REPERFORATORS.~~	
25. ~~CHECK THE TAPE OF TYPING AND NON-TYPING REPERFORATORS AND PERFORATORS FOR CLEAN PUNCHING OF CODE AND FEED HOLES.~~	

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING THE INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. *(Continue on page 4, if more space is needed)*

2 3

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Figure 8. DA Form 11-252, pages 2 and 3.

CHAPTER 4
THEORY

19. Block Diagram Analysis
(fig. 9)

a. When the power switch is turned on, the ac voltage from the power source is applied to the motor, the panel lamp, and to the full-wave rectifier. The full-wave rectifier converts the ac voltage to a dc level required to bias the transistor switch and provide power to operate the magnet assembly.

b. The condition of the signal line controls the transistor switch and magnet assembly which in turn controls the rotation of the mechanical counter. After six characters have been received on the signal line, the mechanical counter will have advanced one digit.

(1) When the signal line is in the idle (marking) condition, the transistor switch is turned *on* and the magnet assembly is energized. This causes the stop lever to block the friction clutch which prevents the mechanical counter from advancing.

(2) When the start (space) pulse is received from the signal line, the transistor switch is turned *off*. This causes the magnet assembly to deenergize and release the stop lever. The friction clutch is released and drives the mechanical counter one-sixth of a revolution.

(3) When the stop (mark) pulse is received from the line, the action is identical with that described for an idle signal line condition ((1) above).

20. Power Circuit
(fig. 10)

When power switch S1 is closed, 115 volts ac at 60 cps is applied across terminals 3 and 4 of terminal board TB1 to panel-illuminating lamp DS1, induction motor B1 (para 22*a*), and the primary of transformer T1. Transformer T1 steps down the voltage to approximately 24 volts ac. Full-wave rectifier CR3 converts the transformer secondary voltage to dc. The dc output voltage of rectifier CR3 provides the proper negative and positive bias potentials through magnet coils L1 and L2 to PNP transistor Q1. Ripple in the dc voltage is filtered by electrolytic capacitor C1.

21. Signal Circuit
(fig. 10)

The signals applied at the signal line through terminals 1 and 2 of terminal board TB1 are current pulses of the on-off type for neutral operation, or reversed polarity pulses for polar operation.

a. Neutral Operation.

(1) During the marking or idle condition (no traffic on the line), the

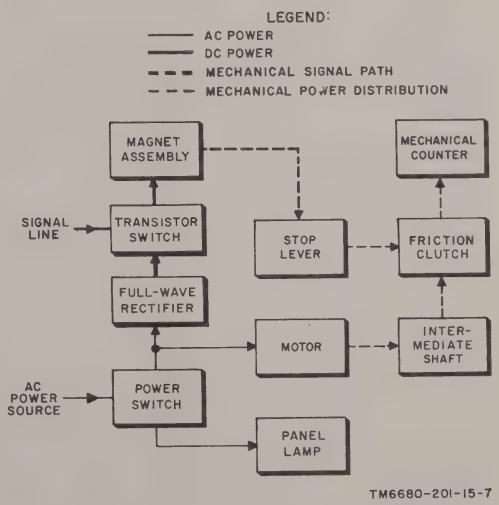


Figure 9. Counter, Electrical CP-612/CG, block diagram.

line current is 20, or 60 milliamperes (ma) dc, with the polarity as shown in figure 10. The potential developed across resistor R1 as a result of the current flow is of proper polarity to forward-bias the base-emitter junction of transistor Q1, turning it *on*, and permitting current flow through magnet coils L1 and L2.

(2) When a start pulse (space, no current) is applied to the signal line, no difference of potential exists between the base and emitter. Transistor Q1 turns *off*, and the current flow through magnet coils L1 and L2 ceases.

b. Polar Operation.

(1) During the marking or idle condition, the line current is approximately 30 ma dc with the polarity as indicated in figure 10. The effect on transistor Q1 is the same as that given in *a*(1) above.

(2) When a start pulse (space, *current reversal*) is applied to the signal line, the base-emitter junction is reverse biased by the potential developed across the parallel combination of resistors R1 and R2 and diode CR1. Transistor Q1 turns *off*, and the current flow through magnet coils L1 and L2 ceases. Diodes CR1 and CR2 prevent the full line current from damaging transistor Q1 during a spacing pulse of the polar signal.

22. Mechanical Operation (fig. 11)

a. Motor B1. Motor B1 operates continuously as long as ac power is applied (para 20). The motor is equipped with a nylon fan to provide air circulation and cooling for the word counter. Motor speed is sufficiently constant so that the word counter will operate correctly with marking or spacing bias or end distortion up to 40 percent. The motor shaft and motor drive worm gear rotate clockwise when viewed from the worm gear end.

b. Speed Gear and Intermediate Shaft. The rotation of the motor worm gear drives the speed gear and the intermediate shaft in the direction indicated in figure 11. The speed of rotation of the intermediate shaft is determined by the speed gear used.

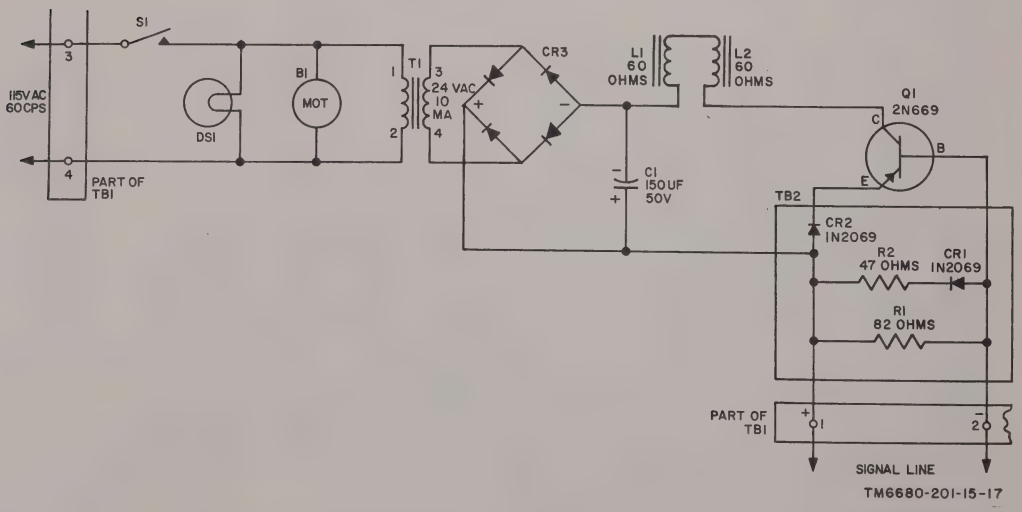


Figure 10. Counter, Electrical CP-612/GG, schematic diagram.

c. Friction Clutch, Stop Lever, and Counter Drive. The driver plate is blocked or released by the stop lever which extends from the armature bail. The stop lever has two arms which are capable of blocking clutch drive. The operation of the magnet coils (para 21) and the armature moves the stop lever in and out of engagement with one of the six slots on the clutch driver plate. The receipt of a start pulse on the signal line causes the stop lever to release the clutch driver plate for one-sixth of a revolution.

(1) In either neutral or polar operation with the signal line in a marking condition, the magnet coils are energized (para 21*a*(1) and *b*(1)). The armature (not shown) and the armature bail are drawn toward the magnet coils, and the stop lever and upper arm are moved in the direction indicated in figure 11. The lower stop lever arm (not shown) is in a slot on the clutch driver plate; this blocks rotation of the counter coupling and gear ((2) below).

(2) Upon receipt of the start (space) pulse, the magnet coils deenergize (para 21*a*(2) and *b*(2)) and permit the return spring to pull the armature bail away from the magnet coils. The stop lever, fastened to the armature bail, moves down and disengages the lower stop lever arm from the notch in the clutch driver plate. This allows the friction clutch to drive the counter coupling which operates the counter through the worm gear and counter gear. When the clutch driver plate is released, it makes one-sixth of a revolution for each received character. The impulses that occur between the start and stop impulses have no effect on the driver plate. When the stop impulse is received, the magnet coil reenergizes and the lower stop lever arm engages the next notch in the driver plate and blocks rotation of the counter coupling. After six characters have actuated the transistor switch and the magnet coils, the clutch driver plate will have completed 1 revolution and the counter will have advanced one number. If an open line should occur, the upper stop lever arm will block the clutch and counter rotation until line current is restored. This prevents false counts from being registered.

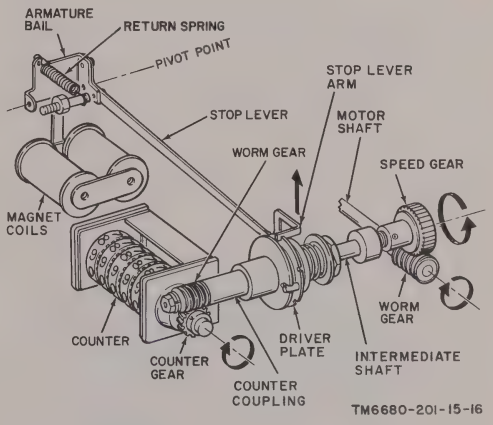


Figure 11. Mechanical operation of word counter.

CHAPTER 5
THIRD ECHELON MAINTENANCE

Section I. PREVENTIVE MAINTENANCE AND LUBRICATION

23. Scope of Third Echelon Maintenance

Third echelon maintenance for the CP-612/GG consists of the following:

a. Preventive maintenance (para 25).

b. Lubrication (para 26).

c. Troubleshooting (para 27 and 28).

d. Voltage and resistance measurements (para 29).

e. Replacement of parts (para 30 through 44).

f. Adjustments (para 45 through 52).

g. Third echelon testing procedures (para 53 and 54).

24. Test Equipment, Tools, and Materials Required

a. Test Equipment

Nomenclature	Technical manual
Multimeter TS-352(*)/U[a]	TM 11-5527
Test Set TS-2(*)/TG[b]	TM 11-2208
Rectifier RA-87 (or equivalent)	TM 11-957

[a]Indicates Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
[b]Indicates Test Sets TS-2-TG, TS-2A/TG, TS-2B/TG, and TS-2C/TG.

b. Tools. The tools required for third echelon maintenance are in Tool Equipment TE-50-B.

c. Materials.

Note: Refer to paragraph 53*b* for additional materials required for third echelon testing.

Item	Stock No.
Cleaning Compound	7930-395-9542 (Fed)
Solvent (SD)	51-S-4385 (QMC)
Cheesecloth, bleached, 36 inches wide	6Z1989 (Sig C)
Oil, Lubricating	9150-498-8318 (Fed)
Oil, Lubricating, Felt	9150-K60-4299 (Fed)
Sandpaper, flint, #0000, 9- × 10-inch	42-P-1154-10 (Ord C)

Warning: Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.

25. Preventive Maintenance

a. DA Form 11-252 (fig. 7 and 8) is to be used by third echelon maintenance personnel performing preventive maintenance on the CP-612/GG. Items not applicable to the CP-612/GG are lined out in the figure.

b. When preventive maintenance routines are performed, check all parts for dirt, rust, corrosion, fungus, and signs of wear whether or not these parts are listed specifically on the form.

(1) If available, use vacuum cleaning equipment for removing loose dust, paper, lint, and dirt from the interior of the word counter. Compressed dry air may be used, but the pressure must be kept low enough to prevent equipment damage.

(2) Use a cloth moistened with solvent (SD) to clean the covers, the chassis, and the metallic parts (except electrical parts). Wipe solvent (SD) and dirt from the parts with a clean dry cloth.

(3) Wipe the electrical parts with a clean dry cloth.

26. Lubrication Instructions

a. Recommended Lubricants. The recommended lubricants for the word counter are Oil, Lubricating (Federal stock No. 9150-498-8318) and Oil, Lubricating, Felt (Federal stock No. 9150-K60-4299).

b. Lubrication Schedules. Lubricate the clutch felt washers every 200 hours of operation. Lubricate all other items that require lubrication (*e* below) every 2,000 hours of operation.

c. Preparation for Lubrication. Remove the unit from service and remove the rear cover (para 9*a*) and the front plate and housing (para 14*b*).

d. Method of Application. Where only one or two drops of lubricant are required, use a piece of wire approximately 0.030-inch diameter. Dip the end of the wire about one-half inch into the oil to collect a small amount on the end of the wire; then touch the wire to the lubrication point. Use the oiler supplied with Tool Equipment TE-50-B to apply oil, (FSN 9150-498-8318) to all other items (*e* below). Apply oil (FSN 9150-K60-4299) to the clutch felt washers. Use a small pointed brush.

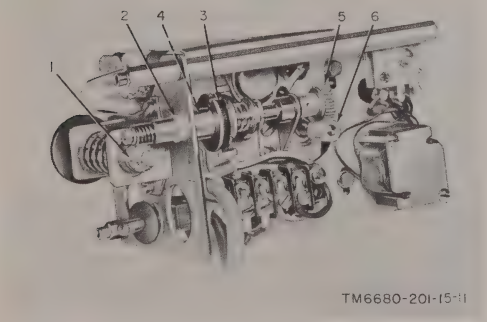
Caution: **Oil, Lubricating, Felt (FSN 9150-K60-4299) is an abrasive; use it only on the clutch felt washers.**

e. Lubrication Points. The points to be lubricated and the quantity of lubricant to be applied are listed in the following chart and illustrated in figures 12 and 13. The item numbers listed in the charts correspond to the item numbers on the figure being referenced. Be sure to wipe all old lubricant from the parts with a clean, dry, lint-free cloth before applying fresh lubricant.

Caution: **Do not over lubricate. Excessive lubrication is a common cause of damage to wire insulation.**

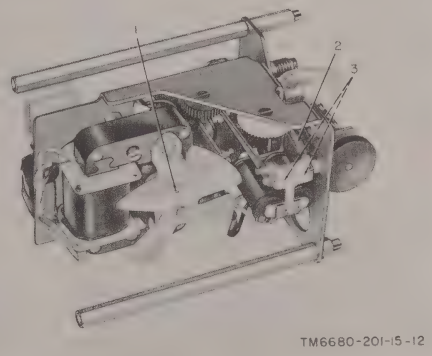
Fig. No.	Item No.	Name of part	Method and quantity
12	1	Counter gear	Apply sparingly around gear teeth.
12	2	Nylon flanged bearing	Apply lightly around inner lip.
12	3	Clutch felt washers	10 to 15 drops on felt washers.
12	4	Nylon sleeve bearing and coupling flanged bearing[a]	Apply lightly around inner lip.
12	5	Intermediate shaft drive gear	Apply sparingly around gear teeth.
12	6	Motor worm gear	Apply sparingly around gear teeth.
13	1	Motor bearings (2)	2 or 3 drops on each bearing.
13	2	Armature spring	2 or 3 drops, spread with finger.
13	3	Stop lever pivot felt washers	10 drops on each washer.

[a]It is necessary to remove the counter control shaft assembly (para 34) and disassemble it (para 42) to lubricate these items.



1 Counter gear
2 Nylon flanged bearing
3 Clutch felt washer (2)
4 Nylon sleeve bearing and coupling flanged bearing
5 Intermediate shaft drive gear
6 Motor worm gear

Figure 12. Word counter, lubrication points, right view.



1 Motor bearing (2)
2 Stop lever pivot felt washer (2)
3 Armature spring

Figure 13. Word counter, lubrication points, left view.

27. Localizing Troubles

When trouble has been sectionalized to the word counter and the cause is not immediately apparent, proceed as follows:

a. Obtain as much information as possible from the operator regarding equipment performance at the time the trouble occurred.

b. Make a visual inspection of the unit to determine if the trouble is caused by loose line or power connections.

c. Perform the procedures outlined in the installer's checklist (para 13) to localize the trouble.

d. After the trouble has been localized, refer to the troubleshooting checklist (para 28) and the voltage and resistance measurements to isolate the trouble to a specific part.

28. Troubleshooting Checklist

The following chart is provided as an aid in isolating troubles in the CP-612/GG. When the trouble has been isolated to the electrical components, check the voltage and resistance measurements (para 29) to determine the faulty component.

Condition	Probable trouble	Correction
Neither lamp nor motor energizes when power switch is turned on.	Disconnected power cord at power source or terminal board.	Connect plug at power source; connect power cord to terminal board (fig. 14).
	Disconnected or broken leads.	Resolder or replace leads (fig. 14).
	Faulty power switch.	Replace power switch.
Motor starts but lamp does not light.	Lamp burned out.	Replace lamp.
	Disconnected or broken lamp leads.	Resolder or replace leads (fig. 14).
	Defective lamp socket.	Replace lamp socket.
Lamp lights but motor does not start.	Disconnected or broken leads.	Resolder or replace lead (fig. 14).
	Faulty motor.	Replace motor (para 35).
Counter advances erratically.	Clutch out of adjustment.	Adjust clutch (para 49).
Counter does not advance.	Clutch out of adjustment.	Adjust clutch (para 49).
	Stop lever pivot eccentric out of adjustment.	Adjust pivot eccentric (para 50).
	Magnet coils do not attract armature.	Refer to troubles and corrections for item below.
	Defective counter.	Replace counter (para 33).
Magnet coils do not attract armature.	Disconnected or broken signal line wiring in unit.	Resolder or replace wiring (fig. 14).
	Faulty rectifier CR3, transformer T1, transistor Q1, or coils L1, L2.	Refer to paragraph 29.

29. Voltage and Resistance Measurements (fig. 14)

The dc voltage measurements in the charts below are given for 20- and 60-ma line circuit operation. The voltage measurement in parenthesis is given for 60-ma operation. Unless otherwise specified, the values given for voltage and resistance may vary ±10 percent. All resistance measurements are made with power disconnected.

a. Measurements at Terminal Board TB1.

Measure across terminals	Conditions	Voltage (volts)	Resistance (ohms)
3-4	Power switch closed.	115 ac	28
3-4	Power switch open.	115 ac	Infinity
1-2	No traffic on line (mark condition), positive lead of meter on term. 2 of TB1.	1.2 dc (1.4 dc)	45 ± 10
1-2	Open line (space condition), positive lead of meter on term. 1 of TB1.	0	20 ± 5

b. Transistor Voltage Measurements.

Points of measurement	Conditions	Voltage (volts dc)
Emitter to base	No traffic on line (mark condition), positive lead of meter on emitter.	1.4
	Open line (space condition), positive lead of meter on base.	0
Emitter to collector	No traffic on line (mark condition), positive lead of meter on emitter.	0
	Open line (space condition), positive lead of meter on emitter.	30 ± 10

c. Dc Resistances of Magnet Coils, Transformer, and Diodes.

Note: For diode measurements, second ohmmeter test lead is connected to other side of the diode.

Item	Conditions	Resistance (ohms)
Diode CR1	In circuit measurements:	
	Negative lead on term. 2 of TB1.	90
	Positive lead on term. 2 of TB1.	12
Diode CR2	In circuit measurements:	
	Negative lead on emitter of Q1.	12
	Positive lead on emitter of Q1.	50
Transformer T1 windings:	Disconnected from circuit.	
1-2		360
3-4		22
Magnet coils L1 and L2	Disconnected from circuit.	60 (each)

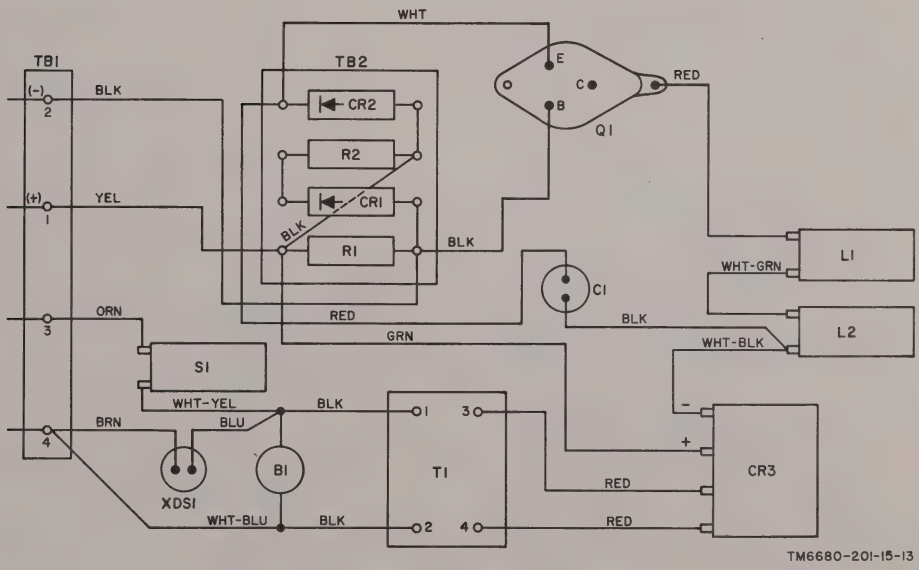


Figure 14. Counter, Electrical CP-612/GG, wiring diagram.

30. General

The word counter consists of several assemblies and individual components mounted on the chassis. The procedures given in this section will enable the repairman to strip the word counter to its chassis. However, it is possible to replace individual components without completely disassembling the word counter. *Do not disassemble beyond the point necessary to inspect and replace a component.* Follow the procedures below to repair the word counter.

a. Disconnect all power from the word counter (para 12).

b. When necessary remove the word counter from the MT-2684/GG (para 14).

c. Perform the appropriate repair procedure (para 32 through 43).

Note: When the spring pins are removed, discard them and use new pins when reassembling; be sure that the hole in the shaft is aligned with the hole in the part to be pinned to the shaft. Insert the beveled end of a spring pin into the hole, support the shaft firmly, and tap the spring pin *lightly* until the parts are secured.

d. When all repairs are completed, lubricate (para 26) and adjust the word counter as described in paragraphs 45 through 51.

Caution: **Do not tighten the screws excessively.**

31. Tools and Shop Equipment

a. Tools. Tool Equipment TE-50-B includes the tools required for field repair of the work counter.

b. Shop Equipment. In addition to the tools in the TE-50-B, depot repair requires metal working tools, numbered and fractional size drill sets, and National Coarse and National Fine tap and die sets.

32. Removal and Replacement of Front Panel and Housing, Lamp, and Rear Cover
(fig. 15)

a. Removal.

(1) Remove the two machine screws (1) that attach the front plate (4) and housing (2) to the upper and lower studs (17 and 18), and remove the front plate and housing. Remove lamp DS1(15), if defective.

(2) Remove the two machine screws (5) and nonmetallic washers (6), and withdraw the rear cover (7) from the word counter.

b. Replacement.

(1) Install a new lamp DS1(15), position the front plate (4) and housing (2) over the upper and lower studs (17 and 18), and secure them in place with the two machine screws (1).

(2) Position the rear cover (7) over the diagonally mounted case posts (20) and secure it with the machine screws (5) and nonmetallic washers (6).

33. Removal and Replacement of Counter Assembly
(fig. 16)

a. Removal.

(1) Remove the front plate and housing (para 32*a*(1)).

(2) Remove the three machine screws (1), lockwashers (2), and flat washers (3), and remove the counter assembly (4) and the counter plate (9) from the chassis.

b. Replacement.

(1) Position the counter plate (9) with the counter assembly (4) on the front chassis and secure them in place with the three machine screws (1), lockwashers (2), and flat washers (3).

(2) Adjust the counter gear backlash (para 46).

(3) Replace the front plate and the housing (para 32*b*(1)).

34. Removal and Replacement of Counter Control Shaft Assembly
(fig. 16)

a. Removal.

(1) Remove the front plate and housing and the rear cover (para 32*a*).

(2) Remove the two machine screws (14) and lockwashers (15) that attach the support bracket (19) to the chassis at point A, and carefully remove the counter control shaft assembly (16 through 30).
(3) Slip the assembled coupling parts (31 through 37) from the flanged bearing (38) in the chassis plate.

b. Replacement.
(1) Slip the assembled coupling parts (31 through 37) into the flanged bearing (38) in the chassis plate.
(2) Insert the free end of the intermediate shaft (30) into the bearings (31 and 32) and the coupling (37), and secure the support bracket (19) to the chassis at point A with the two machine screws (14) and lockwashers (15).
(3) Adjust the counter and speed gear backlash (para 46 and 48).
(4) Replace the front plate and housing and the rear cover (para 32*b*).

35. Removal and Replacement of Motor Assembly

a. Removal.
(1) Remove the rear cover (para 32*a* (2)).
(2) Unsolder the leads at the motor terminals (fig. 14).
(3) Remove the two hexagonal-head screws (1, fig. 17), lockwashers (2), flat washers (3), and spacers (9), and remove the motor assembly (4) from the chassis.

b. Replacement.
(1) Position the motor assembly (4) so that the worm gear extends through the hole in the chassis and the mounting holes are aligned with the spacers (9).
(2) Secure the motor assembly to the chassis with the two hexagonal-head screws (1), lockwashers (2), and flat washers (3), but do not tighten.
(3) Adjust the speed gear backlash (para 48).
(4) Resolder the leads at the motor terminals (fig. 14).
(5) Replace the rear cover (para 32*b* (2)).

36. Removal and Replacement of Stop Lever and Bail Assembly (fig. 17)

a. Removal.
(1) Remove the rear cover (para 32*a* (2)).
(2) Unhook the armature return spring (11) from the armature bail (19) and the spring post (fig. 22).
(3) Remove the retaining ring (12) from the pivot post (25, fig. 19).
(4) Remove the two machine screws (13), lockwashers (14), and flat washers (15), slip the stop lever (16) off the bail pivot post (25, fig. 19), and withdraw it from the opposite side of the chassis.
(5) Slip the armature bail (19) from the bail pivot post (25, fig. 19); be careful not to lose the bail spring (21) and the two felt washers (22).

b. Replacement.
(1) Slip the armature bail (19) onto the bail pivot post (25, fig. 19) so that the bail pivot post extends through the bail spring (21) and the two felt washers (22).
(2) Place the end of the stop lever (16) through the hole from the opposite side of the chassis and slip it on the bail pivot post (25, fig. 19).
(3) Replace the retaining ring (12) on the end of the bail pivot post (25, fig. 19) and secure the stop lever (16) to the armature bail (19) with the two machine screws (13), lockwashers (14), and flat washers (15).
(4) Hook the armature return spring (11) onto the armature bail (19) and the spring post (fig. 22).
(5) Adjust the stop lever pivot eccentric, the stop lever position, and the stop lever spring tension (para 50 through 52).
(6) Replace the rear cover (para 32*b* (2)).

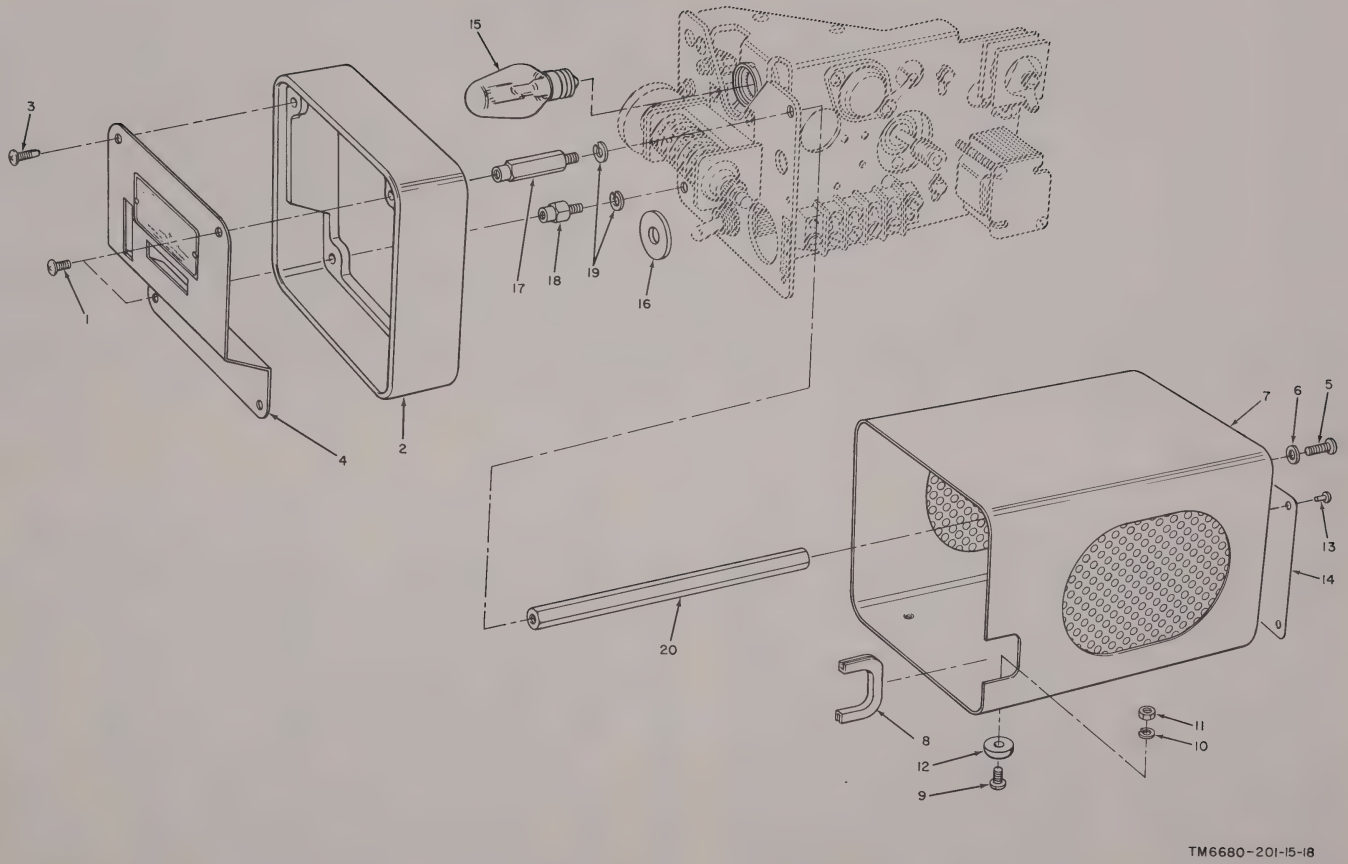
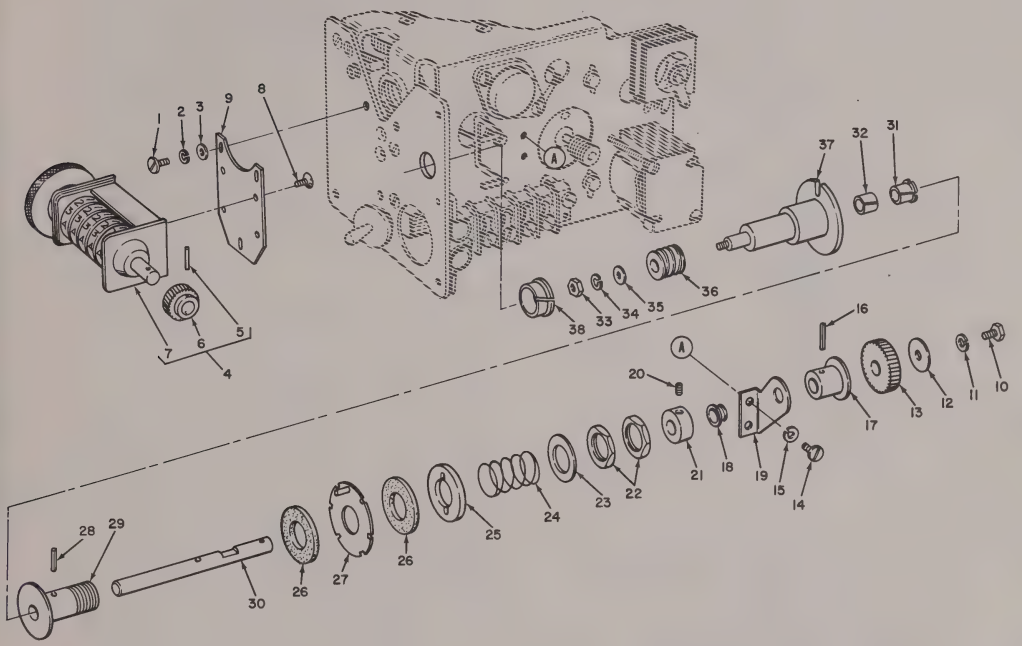


Figure 15. Front plate and housing and rear cover, exploded view.

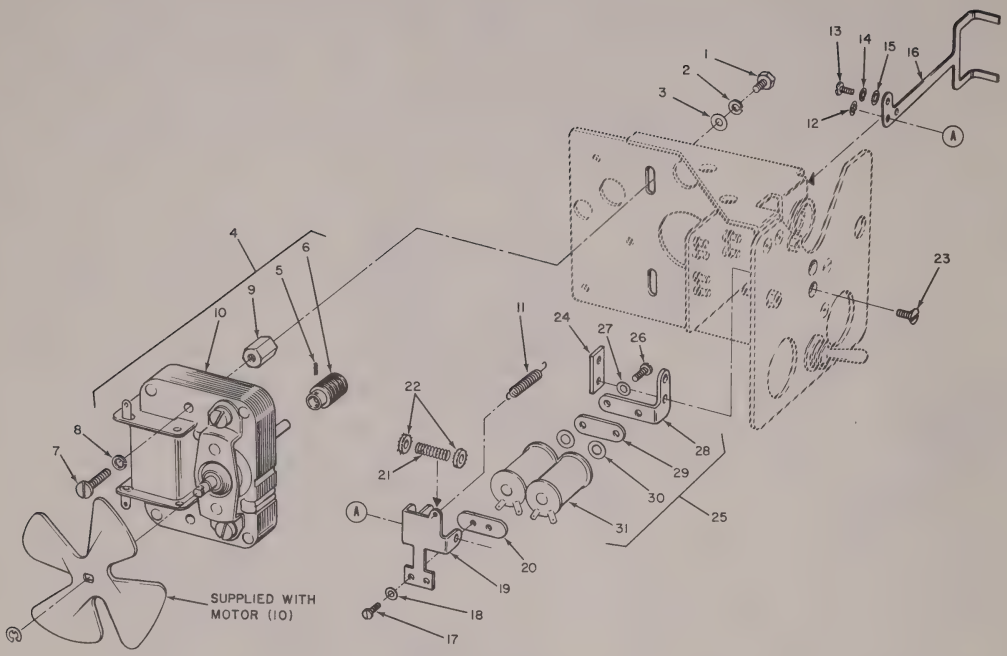
1 Machine screw H81 (2)
2 Housing MP30
3 Machine screw H54 (2)
4 Front plate A13
5 Machine screw H83 (2)
6 Nonmetallic washer H82 (2)
7 Rear cover A1
8 Neoprene grommet MP4
9 Machine screw H2 (4)
10 Lockwasher H3 (4)
11 Hexagonal nut H4 (4)
12 Mounting foot MP3 (4)
13 Rivet H1 (4)
14 Instruction plate MP2
15 Lamp DS1, (incandescent)
16 Insulating washer H76
17 Upper stud MP42
18 Lower stud MP40
19 Lockwasher H70, H71, (2)
20 Case post MP43 (2)

Figure 15. Continued.



1 Machine screw H73 (3)
2 Lockwasher H74 (3)
3 Flat washer H75 (3)
4 Counter assembly A2
5 Spring pin H5
6 Counter gear MP5
7 Counter M1
8 Machine screw H72 (4)
9 Counter plate MP44
10 Hexagonal-head screw H64
11 Lockwasher H65
12 Flat Washer H66
13 Speed gear, 100 wpm MP39
14 Machine screw H62 (2)
15 Lockwasher H63 (2)
16 Spring pin H47
17 Gear hub MP28
18 Flanged bearing MP27
19 Support bracket MP26
20 Setscrew H46
21 Collar MP25
22 Clutch torque locknuts H45 (2)
23 Flat washer H44
24 Clutch spring MP24
25 Clutch disk H43
26 Felt washer H39, H42
27 Driver plate disk A9
28 Spring pin H41
29 Clutch sleeve MP22
30 Intermediate shaft MP21
31 Coupling flanged bearing (nylon) MP36
32 Sleeve bearing (nylon) MP37
33 Hexagonal nut H38
34 Lockwasher H37
35 Flat washer H36
36 Worm gear MP20
37 Coupling CP1
38 Flanged bearing (nylon) MP17

Figure 16. Counter and counter control shaft assemblies, exploded view.



1 Hexagonal-head screw H67 (2)
2 Lockwasher H68 (2)
3 Flat washer H69 (2)
4 Motor assembly A11
5 Spring pin H48 (part of item 4)
6 Worm gear MP29 (part of item 4)
7 Machine screw H50 (part of item 4) (2)
8 Lockwasher H51 (part of item 4) (2)
9 Spacer H49 (part of item 4) (2)
10 Motor with fan B1 (part of item 4)
11 Armature return spring MP38
12 Retaining ring H58
13 Machine screw H59 (2)
14 Lockwasher H60 (2)
15 Flat washer H61 (2)
16 Stop lever MP35
17 Machine screw H34 (2)
18 Lockwasher H35 (2)
19 Armature bail MP18
20 Armature MP19
21 Bail spring MP34
22 Felt washer MP33 (2)
23 Machine screw H26 (2)
24 Threaded plate H27
25 Magnet assembly A5
26 Machine screw (nonmagnetic) H23 (part of item 25) (2)
27 Lockwasher H25 (part of item 25)
28 Coil bracket MP13 (part of item 25)
29 Spacer H22 (part of item 25)
30 Brass washer H24 (part of item 25) (2)
31 Coils L1, L2 (part of item 25)

Figure 17. Motor, bail, and magnet assembly, exploded view.

37. Removal and Replacement of Magnet Assembly
(fig. 17)

a. Removal.

(1) Remove the front plate and housing, and the rear cover (para 32*a*).

(2) Disconnect the leads to the terminals of coils L1 and L2 (fig. 14).

(3) Remove the two machine screws (23) and the threaded plate (24) that hold the magnet assembly (25) to the chassis plate. Remove the magnet assembly (25).

b. Disassembly.

(1) Remove the two nonmagnetic machine screws (26) and lockwashers (27).

(2) Remove the coil bracket (28), the spacer (29), and the brass washers (30) from coils L1 and L2 (31).

c. Reassembly.

(1) Place a brass washer (30) over the end of each coil (31).

(2) Place the spacer (29) and the coil bracket (28) over the ends of the coils and secure them in place with the two nonmagnetic machine screws (26) and lockwashers (27).

d. Replacement.

(1) Position the magnet assembly (25) and the threaded plate (24) against the chassis from beneath the armature bail (19), and secure them in place with the two machine screws (23).

(2) Reconnect the leads to the terminals of coils L1 and L2 (fig. 14).

(3) Replace the front plate and housing and the rear cover (para 32*b*).

38. Removal and Replacement of Terminal Board TB1
(fig. 18)

a. Removal.

(1) Remove the rear cover (para 32*a* (2)).

(2) Disconnect the line and power cords from the terminals of terminal board TB1.

(3) Remove the two machine screws (5), lockwashers (6), and flat washers (7).

(4) Pull terminal board TB1 (8) away from the chassis and remove the two flat washers (7) and spacers (9).

(5) Unsolder the leads from terminal board TB1 (fig. 14) and remove the terminal board.

b. Replacement.

(1) Solder the leads to terminal board TB1 (fig. 14).

(2) Position terminal board TB1 (8) on the chassis and replace the two spacers (9) and flat washers (7).

(3) Secure terminal board TB1 (8) in place with the two machine screws (5), lockwashers (6), and flat washers (7).

(4) Reconnect the line and power cords to the terminals of terminal board TB1 (para 10).

(5) Replace the rear cover (para 32*b* (2)).

39. Removal and Replacement of Electrical and Miscellaneous Components

Most components are readily accessible for removal and replacement after the front plate and housing, and the rear cover have been removed (para 32). If a component to be removed is blocked, refer to the appropriate removal and replacement paragraph to remove the assembly and to reach the component.

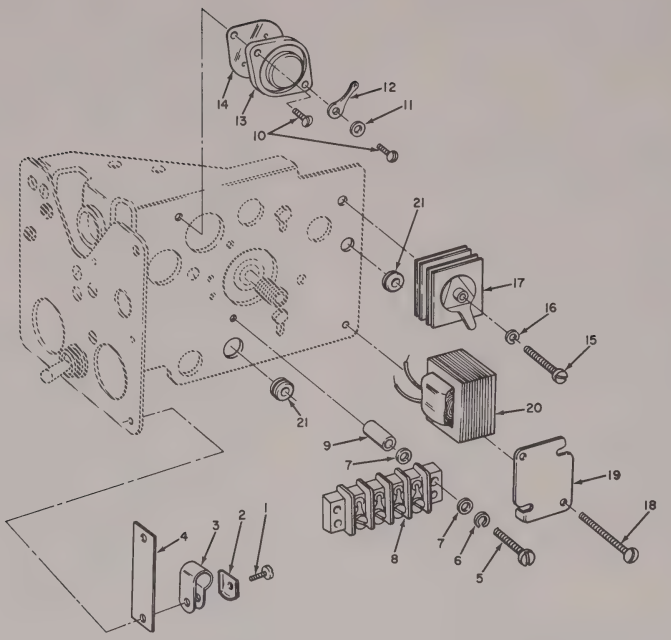
Note: When removing the electrical parts for replacement, unsolder the appropriate leads as indicated on the wiring diagram (fig. 14). Refer to figure 30 for the resistor color code.

a. When removing transistor Q1 (13, fig. 18), be careful not to lose the insulator (14). Be sure to replace the collector-connecting terminal lug (12) when replacing transistor Q1 (13).

b. Rectifier CR3 (17) is secured to the chassis with a single machine screw (15) and flat washer (16).

c. Transformer T1 (20) is secured to the chassis with the transformer plate (19) and two machine screws (18).

d. Speed gears (21, fig. 19) and (22) are secured to the chassis with machine screws (19) for storage only.



TM6680-201-15-20

1 Machine screw H33 (2)
2 Special washer H32 (2)
3 Cord clamp MP16 (2)
4 Insulator E5
5 Machine screw H80 (4)
6 Lockwasher H78 (4)
7 Flat washer H79 (8)
8 Terminal board TB1
9 Spacer H77 (4)
10 Machine screw H17 (2)
11 Flat washer H18 (2)
12 Terminal lug E2
13 Transistor Q1
14 Insulator E1
15 Machine screw H19
16 Flat washer H20
17 Rectifier CR3
18 Machine screw H21 (2)
19 Transformer plate MP12
20 Transformer T1
21 Rubber grommet MP7 (2)

Figure 18. Electrical components, exploded view.

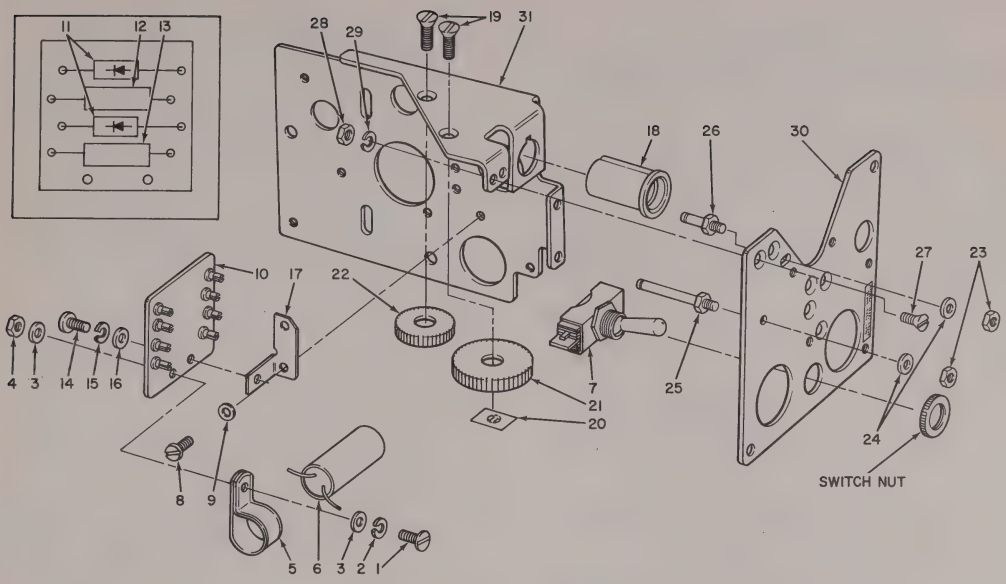
e. Terminal board TB2 (10) is secured to the terminal board bracket (17) which is secured to the chassis with two machine screws (8) and flat washers (9).

40. Disassembly and Reassembly of Front Plate and Housing and Rear Cover (fig. 15)

a. Disassembly.

(1) Remove the front plate and housing and the rear cover (para 32*a*).
(2) Remove the two diagonally mounted machine screws (3) and remove the front plate (4) from the housing (2).
(3) Remove the neoprene grommet (8) from the rear cover (7).
(4) Remove the machine screw (9), lockwasher (10), and the hexagonal nut (11) that secure each mounting foot (12) to the rear cover (7).

b. Reassembly. To reassemble the front plate and the housing and the rear cover, reverse the procedures given in *a* above. Replace the front plate, the housing, and the rear cover (para 32*b*).



TM6680-201-15-22

1 Machine screw H11
2 Lockwasher H12
3 Flat washer H13
4 Hexagonal nut H14
5 Capacitor clamp MP11
6 Capacitor C1
7 Toggle switch S1
8 Machine screw H15 (2)
9 Flat washer H16 (2)
10 Terminal board TB2
11 Diodes CR1, CR2 (2)
12 Resistor R1
13 Resistor R2
14 Machine screw H8
15 Lockwasher H9
16 Flat washer H10
17 Terminal board bracket MP10
18 Lampholder with nut XDS1
19 Machine screw H6 (2)
20 Sheet metal nut H7 (2)
21 Speed gear, 60 wpm MP8
22 Speed gear, 75 wpm MP9
23 Hexagonal nut H29, H31 (2)
24 Lockwasher H28, H30 (2)
25 Bail pivot post MP15
26 Spring post MP14
27 Machine screw H54 (4)
28 Hexagonal nut H55 (4)
29 Lockwasher H56 (4)
30 Chassis plate MP45
31 Chassis MP6

Figure 19. Terminal board and chassis, exploded view.

41. Disassembly and Reassembly of Counter Assembly
(fig. 16)

a. Disassembly.

(1) Remove the counter assembly from the chassis (para 33*a*).

(2) Remove the four machine screws (8) that secure the counter (7) to the counter plate (9).

(3) Tap the spring pin (5) lightly to remove it from the counter shaft, and slip off the counter gear (6). Use a 0.062-inch pin punch to drive the pin.

b. Reassembly.

(1) Slip the counter gear (6) onto the counter shaft. Secure the counter gear to the shaft with the spring pin (5).

Note: Use a new spring pin (5) when the counter is reassembled.

(2) Replace the four machine screws (8) and secure the counter (7) to the counter plate (9).

(3) Replace the counter assembly on the chassis (para 33*b*).

42. Disassembly and Reassembly of Counter Control Shaft Assembly
(fig. 16)

Note: Use a 0.062-inch pin punch for removal and replacement of the spring pins.

a. Disassembly.

(1) Remove the counter control shaft assembly from the chassis (para 34*a*).

(2) Remove the hexagonal-head screw (10), lockwasher (11), flat washer (12), and the speed gear (13).

(3) Tap the spring pin (16) lightly to remove it from the gear hub (17) and the intermediate shaft (30). Remove the gear hub (17) and the flanged bearing (18) from the support bracket (19).

(4) Remove the intermediate shaft (30) from the flanged bearing (18) and remove the flanged bearing from the support bracket (19).

(5) Loosen the setscrew (20) and remove the collar (21).

(6) Unscrew the clutch torque locknuts (22) from the threaded end of the clutch sleeve (29) and remove the parts (23) through (27) from the clutch sleeve (29).

(7) Tap the spring pin (28) lightly to remove it from the clutch sleeve (29) and the intermediate shaft (30). Remove the clutch sleeve from the intermediate shaft.

(8) Unscrew and remove the hexagonal nut (33), lockwasher (34), flat washer (35), and the worm gear (36) from the coupling (37). Remove the coupling flanged bearings (31) and sleeve bearing (32) from within the coupling (37).

b. Reassembly.

(1) Fasten the worm gear (36) to the coupling (37) with the hexagonal nut (33), lockwasher (34), and flat washer (35).

(2) Lubricate the sleeve bearing (32) and the coupling flanged bearing (31) (para 26), and insert these bearings into the coupling (37).

(3) Insert the end of the intermediate shaft (30) into the coupling (37).

(4) Secure the clutch sleeve (29) to the intermediate shaft (30) with a new spring pin (28).

(5) Place a felt washer (26), driver plate (27), another felt washer (26), clutch disk (25), clutch spring (24), and flat washer (23) on the threaded end of the clutch sleeve (29). Hold them in place with the clutch torque locknuts (22).

(6) Slip the collar (21) onto the end of the intermediate shaft (30) and tighten the setscrew (20) against the flat on the intermediate shaft (30).

(7) Press the flanged bearing (18) into the support bracket (19) and slip the end of the intermediate shaft (30) through the flanged bearing.

(8) Secure the gear hub (17) to the intermediate shaft (30) with a new spring pin (16).

(9) Fasten the speed gear (13) to the gear hub (17) with the hexagonal-head screw (10), lockwasher (11), and flat washer (12).

(10) Replace the counter control shaft assembly (para 34*b*).

(11) Lubricate those parts requiring lubrication (para 26).

(12) Adjust the intermediate shaft end play (para 47) and the clutch torque (para 49).

43. Disassembly and Reassembly of Motor Assembly
(fig. 17)

a. Disassembly.

(1) Remove the motor assembly from the chassis (para 35*a*).

(2) Tap the spring pin (5) lightly to remove it from the motor shaft and remove the worm gear (6).

(3) Remove the retaining ring from the

motor shaft and remove the nylon fan.

b. Reassembly.

(1) Replace the nylon fan on the motor shaft and replace the retaining ring.

(2) Slip the worm gear (6) on the motor shaft. Secure the worm gear (6) to the motor shaft with the spring pin (5). Use a 0.062-inch punch to drive the spring pin.

Note: Use a new spring pin (5) when the motor is being reassembled.

(3) Replace the motor assembly on the chassis (para 35*b*).

44. Spring Data

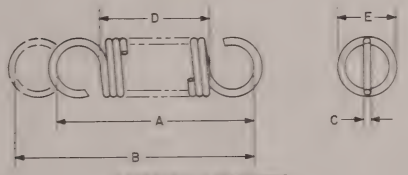
Use the following data to determine whether a spring meets the tension or compression requirement, and replace those springs that do not meet these requirements.

a. Crossed-end Spring (A, fig. 20).

Reference designation	Name	A Free length (in.)	B Extended length (in.)	Reqd tension, extended length	C Wire thickness in.	D Numbers of turns	E Outside diameter (in.)
MP38	Armature return spring	3/4 ± 1/32	31/32	15 ± 1 dc	0.018	23-1/2	11/64 in.

b. Squared-end Springs (B, fig. 20).

Reference designation	Name	A Free length (in.)	B Compressed length (in.)	Reqd pressure, compressed length (in.)	C Wire thickness (in.)	Number of turns	D diameter in.
MP24	Clutch spring	13/32	1/4	6 lb ± 6 oz	0.049	2-1/2	0.493
MP34	Bail spring	7/8	9/32	12 oz ± 1 oz	0.016	15 to 17	0.188



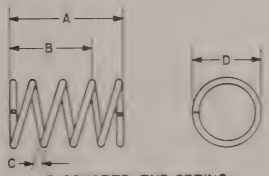


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Figure 20. Word counter spring forms.

45. General

a. This section contains the tolerance requirements and adjustments for the word counter. The adjustment procedures are arranged for a complete readjustment of the word counter. When making individual adjustments, check all related adjustments.

b. Remove the rear cover and the front plate and housing (para 32*a*) to make all adjustments. No further disassembly is required.

46. Counter Gear Backlash Adjustment

a. Requirement. The counter gear (fig. 11) and the worm gear must mesh with a barely perceptible amount of backlash through 1 complete revolution of the counter gear (B, fig. 21).

b. Adjustment.

(1) Loosen the three machine screws (1, figure 16) that secure the counter assembly to the chassis.

(2) Position the counter assembly to obtain the proper gear mesh.

(3) Tighten the three machine screws securely.

47. Intermediate Shaft End Play (A, fig. 21)

a. Requirement. The intermediate shaft must have perceptible end play, not to exceed 0.010 inch.

b. Method of Checking. Check the end play with a 0.008-inch feeler gage (maximum 0.010-inch) between the collar and the flanged bearing.

c. Adjustment. Loosen the collar setscrew and position the collar on the intermediate shaft to obtain the proper end play. Tighten the setscrew securely.

48. Speed Gear Backlash (B, fig. 21)

a. Requirement. The speed gear and motor worm gear must mesh with a barely perceptible amount of backlash through 1 complete revolution of the speed gear.

b. Method of Checking. Rotate the motor

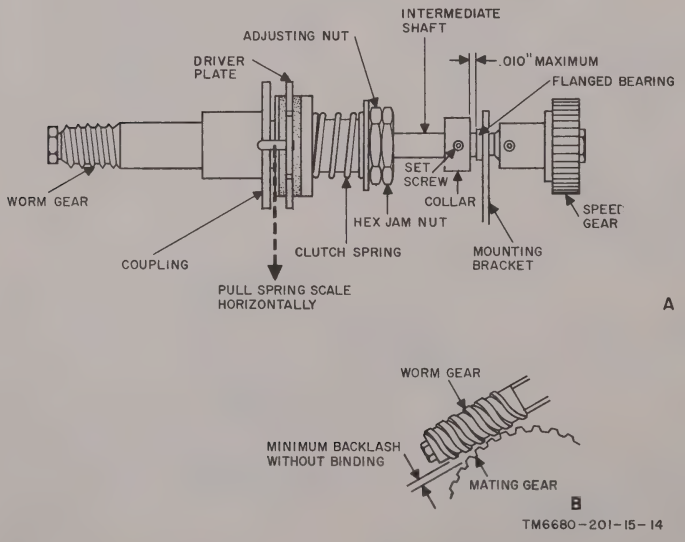


Figure 21. Intermediate shaft end play, clutch torque, and backlash adjustments.

manually and observe for minimum perceptible backlash.

c. Adjustment

(1) Loosen the two motor mounting screws (1, fig. 17).

(2) Position the motor in the elongated screw holes and press the motor shaft in the direction of the fan to observe for proper backlash.

(3) Tighten the motor mounting screws.

49. Clutch Torque (A, fig. 21)

a. Requirement. With the motor running, a pull of 4 to 4-1/2 ounces should be required to keep the driver plate from turning.

b. Method of Checking. Manually operate the armature until the drive pin on the driver plate is in the uppermost position. Engage the hook end of an 8-ounce spring scale with the drive pin and pull in the direction shown in figure 21. Position the stop lever so that both arms are free of the notches in the driver plate. Read the scale.

c. Adjustment. Loosen the hexagonal jamnut and reposition the adjusting nut to meet the requirement (*a* above); tighten the hexagonal jamnut.

50. Stop Lever Pivot Eccentric (fig. 22)

a. Requirement. With the motor running and the armature attracted to the magnet coils, the upper stop arm should be out of alignment with the slot in the driver plate by one-third to two thirds the thickness of the blocking portion of the upper stop arm.

b. Adjustment. Loosen the stop lever pivot hexagonal nut slightly and turn the pivot eccentric until the requirement is met (*a* above); tighten the hexagonal nut securely.

51. Stop Lever Position (fig. 22)

a. Requirement. With a marking signal on the line and with the power applied, the lower stop arm of the stop lever must bottom firmly in a slot of the driver plate.

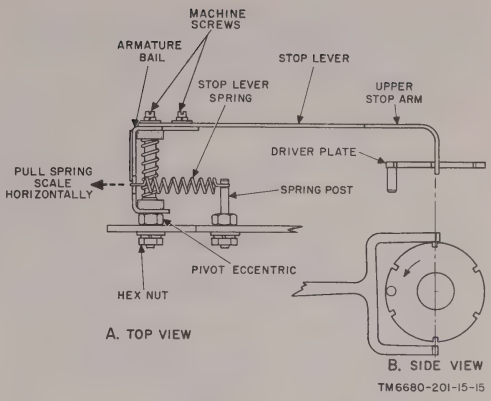


Figure 22. Stop lever pivot eccentric and spring adjustments.

b. Method of Checking. Place a 0.003-inch shim between the armature and the magnet coils. Connect a jumper between terminal 1 of terminal board TB1 and the collector of transistor Q1 (fig. 14), and apply power to the word counter. The lower stop arm should not reach the bottom of the slot in the driver plate.

c. Adjustment. Disconnect the power from the word counter. Loosen the two machine screws (fig. 22). Place a 0.003-inch gage between the armature and the magnet pole faces and manually operate the armature. Position the stop lever to meet the requirement; tighten the two machine screws and recheck the adjustment (*b* above).

52. Stop Lever Spring Tension (fig. 22)

a. Requirement. With the power *off* and the upper stop arm seated in a slot of the driver plate, it should require a pull of 12 to 14 ounces to just start the armature bail moving.

b. Method of Checking. With the power *off*, manually rotate the driver plate until the upper stop arm drops into a slot. Engage the hook end of a spring scale in the

armature bail spring hole and pull the scale in line with the stop lever spring as indicated on figure 22. Read the scale.

c. Adjustment. Loosen the spring post hexagonal nut slightly and move the spring post in the elongated hole to meet the requirement (*a* above); tighten the hexagonal nut securely.

Section V. THIRD ECHELON TESTING PROCEDURES

53. Scope of Third Echelon Testing

a. Third echelon testing includes the following:

(1) Checking the overall operation of the word counter (para 13).

(2) Testing the bias and end distortion tolerance (para 54*b*).

b. The operational test may be performed while the word counter is either part of an operable telegraph circuit or part of the test setup shown in figure 23. Bias and end distortion tolerances of the word counter are checked while the word counter is part of the test setup. The test equipment and tools listed in paragraph 24*a* and *b* are required for these tests. Construct the test circuit (fig. 24); use the components listed in paragraph 56*c*.

54. Bias and End Distortion Tolerance Tests

a. Preparation.

(1) Set the power switch on the word counter to *off* (right). Set the ON-OFF switch on the RA-87 to OFF. Set the MOTOR ON-MOTOR OFF SWITCH on the TS-2(*)/TG to MOTOR OFF.

(2) Check to be sure that the word counter and the TS-2(*)/TG are geared for the same operating speed. If they are not, change the gears of the TS-2(*)/TG to match the speed of the word counter gears.

(3) Set the TS-352(*)/U to measure continuity and determine which of the two conductors of Cable Assembly CX-1200/U is connected to the tip of the plug that is attached to one end of the CX-1200/U. Connect the loose end of this conductor to terminal 2 of terminal board TB1 (fig. 23) on the CP-612/GG. Connect the loosen end of the other conductor to terminal 1 of terminal board TB1.

(4) When the TS-352(*)/U is used as milliammeter M1 in place of a built-in milliammeter in the test circuit (fig. 24), adjust and connect the TS-352(*)/U as follows:

(a) Set the FUNCTION switch of the TS-352(*)/U to DC CURRENT and the RANGE switch to 100 MA. Insert the black test lead into the OHMS -DC ±AC jack and the red test lead into the +DC CURRENT jack of the TS-352(*)/U.

(b) Connect the loose end of the black test lead of the TS-352(*)/U to plug P1 and red test lead to one side of resistor R1 as indicated in figure 24.

(5) Loosen the screws that clamp the adjustable distributor disk of the TS-2(*)/TG, and position the disk to set the pointer at 40. Tighten the screws.

(6) Make all the connections shown in figure 23. Connect the power cord of the RA-87 to a 115-volt ac power source. Set the ON-OFF switch of the RA-87 to ON.

(7) Adjust the knob (that controls variable resistor R1 (fig. 24)) on the test circuit to obtain a 20-ma indication on milliammeter M1.

Note: Do not disturb the test setup until the bias and end distortion tolerance tests (*b* below) have been completed.

b. Tests.

(1) Set the power switch on the word counter to *on* (left).

(2) Set the controls on the TS-2(*)/TG as follows:

(a) The distortion switch to BIAS M (marking bias).

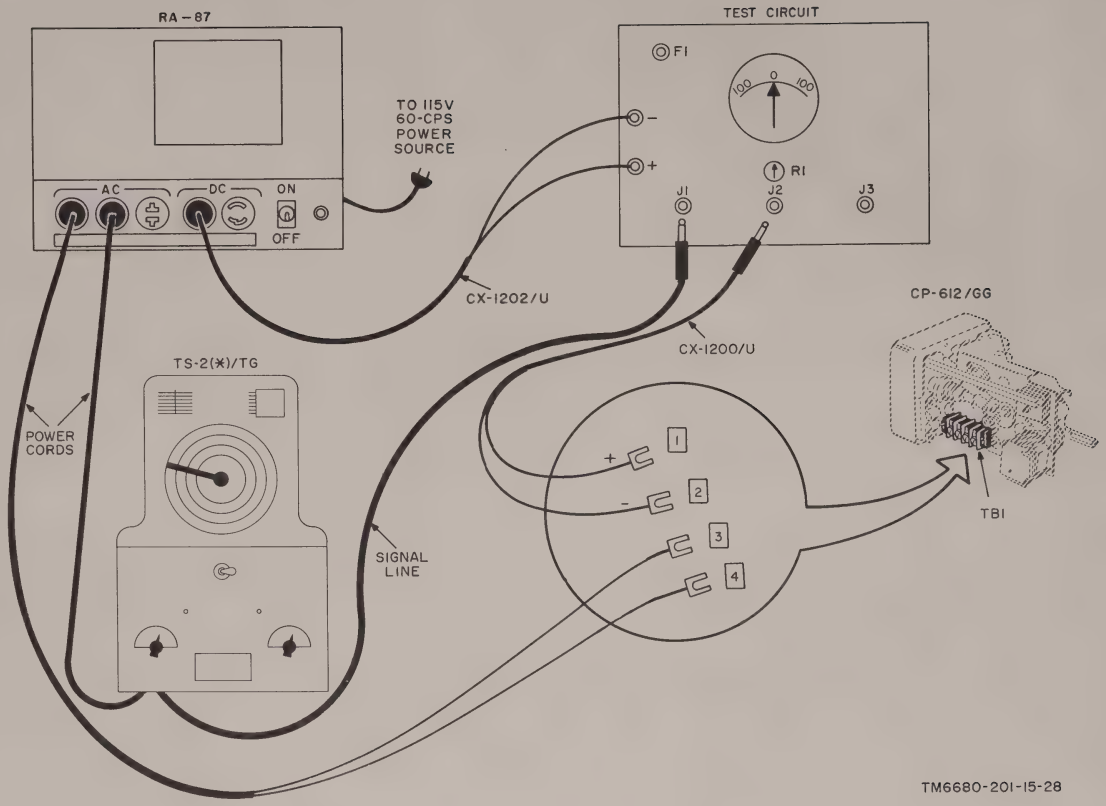


Figure 23. Test setup with Test Set TS-2(*)/TG.

(b) The character-selecting switch to STOP.

(c) The FILTER switch to IN (not applicable to TS-2C/TG).

(d) The DC switch to IN (applicable to TS-2C/TG only).

(e) The MOTOR ON-MOTOR OFF switch to MOTOR ON.

(3) Set the character selecting switch on the TS-2(*)/TG to R or Y for 5 minutes as measured by a stopwatch or electrical timer; set the character selecting switch to STOP.

Note: The timing in obtaining the desired resultant count is critical.

(4) The counter should indicate a count of 500 for operation at 100 wpm 375 for operation at 75 wpm, or 300 for operation at 60 wpm.

(5) Set the distortion switch on the TS-2(*)/TG to BIAS S (spacing bias) and repeat the procedure given in (3) above. The resultant count should be identical to that in (4) above.

(6) Set the distortion switch on the TS-2(*)/TG to ED M (marking end distortion) and repeat the procedure given in (3) above. The resultant count should be identical to that in (4) above.

(7) Set the distortion switch on the TS-2(*)/TG to ED S (spacing and distortion) and repeat the procedure given in (3) above. The resultant count should be identical to that in (4) above.

CHAPTER 6

FOURTH AND FIFTH ECHELON MAINTENANCE

Section I. FOURTH ECHELON TESTING PROCEDURES

55. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance of signal equipment to determine the acceptability of repaired signal equipment. These procedures set forth specific requirements that repaired signal equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide to test the word counter repaired at third echelon if the proper tools and test equipments are available. A summary of the performance standards is given in paragraph 64.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each test in sequence. *Do not vary the sequence.* For each step, perform all the actions required in the *Test equipment control settings* and *Equipment under test control settings* columns; then perform each specific test procedure and verify it against its performance standard.

56. Test Equipment, Tools, and Materials

All test equipment, tools, materials, and other equipment required to perform the testing procedures given in this section are listed in the following charts and are authorized under TA 11-17 and TA 11-100 (11-17).

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
Multimeter TS-352(*)/U[a]	6625-242-5023	TM 11-5527
Distortion Test Set TS-383(*)/GG[b]	6625-322-1714	TM 11-2217
Voltmeter, Meter ME-30(*)/U[c]	6625-669-0742	TM 11-6625-320-12
Ohmmeter ZM-21A/U	6625-246-5880	TM 11-2050

[a]Indicates Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
[b]Indicates Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG.
[c]Indicates Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.

b. Tools. The tools required for fourth echelon testing are in Tool Equipment TE-50-B, Federal stock No. 5180-356-4602.

c. Materials.

Item	Federal stock No.	Quantity
Resistor, variable, 5,000-ohm, 25-watt.	5905-108-6308	1
Resistor, fixed, 1,200-ohm, 20-watt.	5905-156-5997	1
Resistor, variable, 20,000-ohm, 25-watt.	5905-263-2329	1
Jack, telephone, JAN type JJ-089 (normally closed, 2-conductor).	5935-192-4798	3
Fuseholder, cartridge-type.	5920-285-0755	1
Fuse, cartridge, 1/8-amp.	5920-356-2188	1
Meter DC MA, center zero, 0-100 MA range.		1
Wire, copper, insulated, No. 20, hookup.		3 ft

d. Additional Equipment.

Equipment	Federal stock No.	Technical manual
Rectifier RA-87 (or equal).	6130-130-7257	TM 11-957
Variable Power Transformer CN-16B/U (or equal).	5950-235-2086	TM 11-5950-205-15P
Cable Assembly CX-1200/U (2-conductor, 45-in. long, red telephone-type plug at one end) or equal.	5995-170-8780	TM 11-5815-206-12
Power Cable Assembly CX-1202/U (2-conductor, 72-in. long, polarized plug at one end), or equal.	5995-170-8775	TM 11-5815-206-12
Stopwatch or electrical timer (or equal).		

Note: One each of the above equipment except the CX-1200/U are required. Two each of the CX-1200/U are required.

57. Fabrication of Test Circuit

Fabricate the test circuit (fig. 24) to test the word counter. Use the materials listed in paragraph 56c and the CX-1202/U(para 56*d*) to build the test circuit.

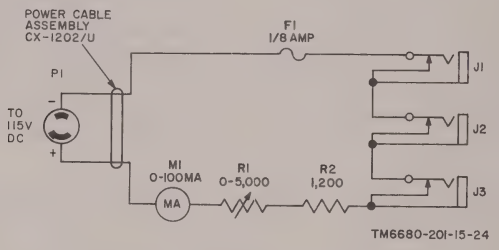


Figure 24. Word counter test circuit, schematic diagram.

58. Physical Tests and Inspections

a. Test Equipment and Materials. Assorted feeler gages and 0- to 32-ounce spring scale.

b. Test Connections and Conditions. Remove rear cover from word counter.

Step	Test equipment control settings	Equipment under test control settings	Test procedures	Performance standards
1	N/A	N/A	*a.* Inspect the word counter for loose or missing screws. *b.* Inspect all cords, spade terminals, and plug for wear, damage, and cleanliness. *c.* Inspect power switch for binding, freedom of movement, and positive action.	*a.* All screws must be tight. None missing. *b.* Cords, terminals, and plug are not worn, bent or damaged and are free from dirt and/or corrosion. *c.* Switch moves freely.
2	N/A	N/A	*a.* Check counter gear and motor gear for backlash. *b.* Check intermediate shaft for end play (measure between collar and mounting bracket). *c.* Insert 0.003-inch feeler gage between armature and one magnet coil and press armature gently toward magnet coils. Repeat with feeler gage, between armature and remaining magnet coil. *d.* Rotate driver plate until upper stop arm of stop lever is centered in slot of driver plate. Hook spring scale at spring hole of stop lever bail and pull horizontally to left in line with armature return spring.	*a.* Counter gear and motor gear shall mesh with mating gears with barely perceptible backlash. *b.* Barely perceptible to 0.010-inch end play. *c.* Feeler stops armature before it touches adjacent magnet coil. *d.* Stop lever bail starts to move when spring scale reads between 12 and 14 ounces.

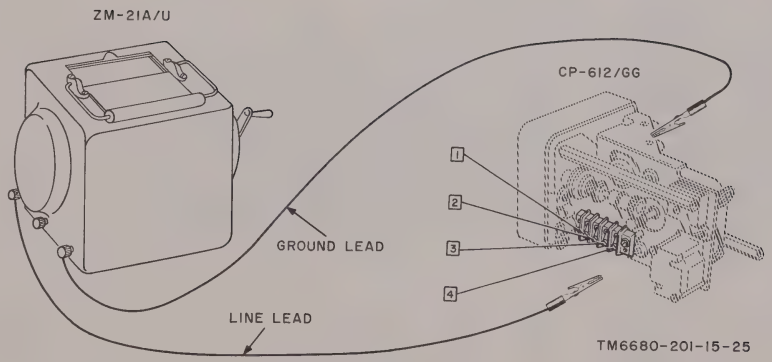


Figure 25. Insulation resistance test setup.

59. Insulation Resistance Test

a. Test Equipment and Materials. Ohmmeter ZM-21A/U.

b. Test Connections and Conditions.

(1) Remove rear cover from word counter.

(2) Disconnect power and signal lines.

(3) Conduct tests at normal room temperature (65-80° F).

(4) Connect the equipment as shown in figure 25.

c. Initial Test Equipment Checks.

(1) With the ZM-21A/U disconnected, crank the hand generator at operating speed (TM 11-2050); the pointer should indicate infinity.

(2) Short the LINE and GROUND terminals and turn the hand generator crank at operating speed; the pointer should indicate zero.

d. Procedure.

Test equipment control settings	Equipment under test control settings	Test procedure	Performance standards
N/A	N/A	Connect the test leads between any point on the chassis and to each terminal of the input terminal board in turn. Rotate the hand generator crank at operating speed.	The ZM-21A/U indicates not less than 100 megohms.

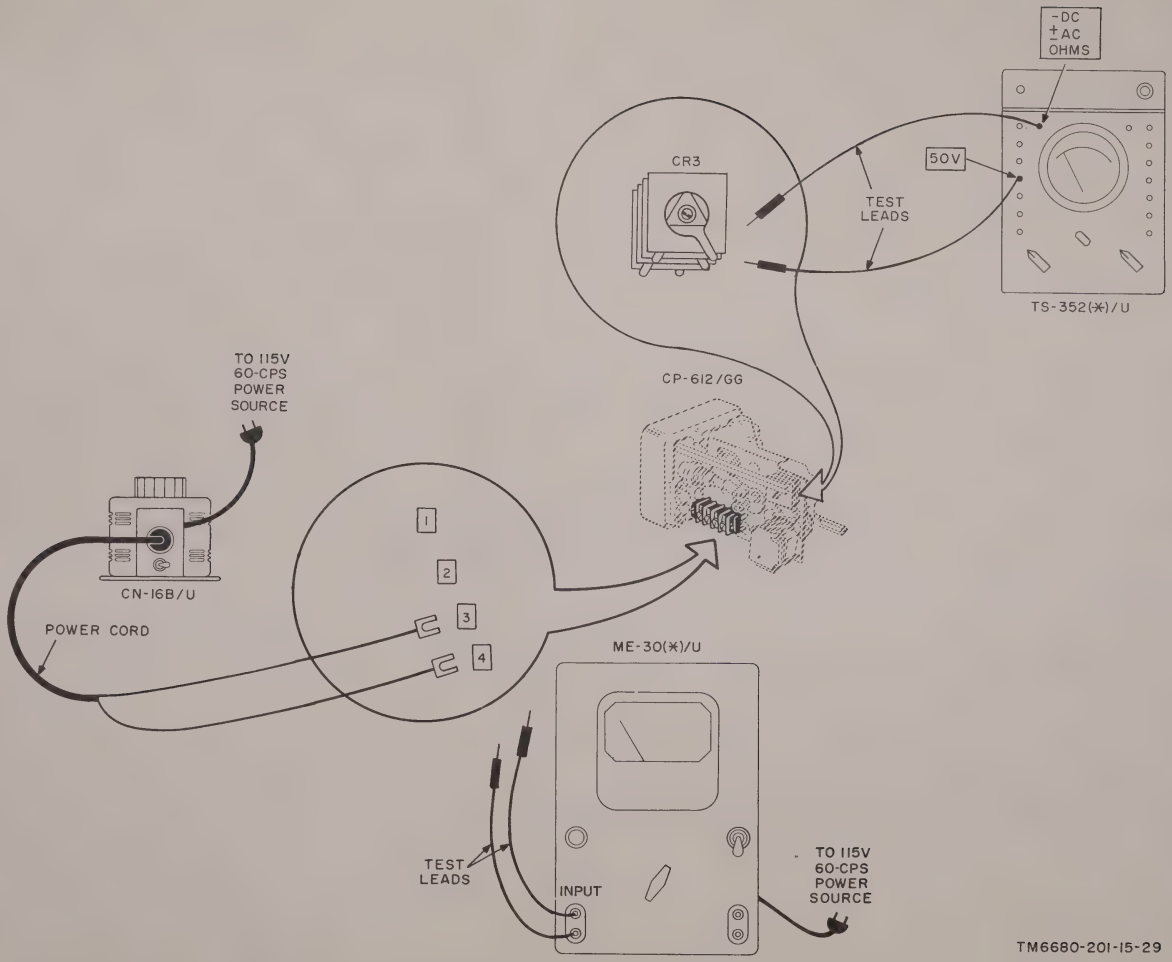


Figure 26. Rectifier voltage test setup.

60. Rectifier Voltage Test

a. Test Equipment and Materials.
(1) Multimeter ME-30(*)/U.
(2) Variable Power Transformer CN-16B/U.
(3) Multimeter TS-352(*)/U.

b. Test Connections and Conditions.
(1) Set the CP-612/GG power switch to OFF.
(2) Set the CN-16B/U for minimum output and operate the power switch to OFF.
(3) Connect the equipment as shown in figure 26 except for the test lead connections.
(4) Operate the CN-16B/U power switch to ON.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedures	Performance standards
1	*ME-30(*)/U:* Range selector switch: 300 VOLTS. *CN-16B/U:* Adjust for 105 volts ac indication on ME-30(*)/U. *ME-30(*)/U:* Range selector switch: 30 VOLTS *TS-352(*)/U* FUNCTION switch: DIRECT.	N/A. N/A. Power switch ON.	*a.* Connect the ME-30(*)/U test leads to terminals 3 and 4 of terminal board TB1 on the CP-612/GG. *b.* N/A. *c.* Connect ME-30(*)/U to the input terminals (marked with yellow paint) of rectifier CR3. *d.* Connect TS-352(*)/U test leads to the output terminals (marked red and black) of rectifier CR3. Observe proper polarity.	*a.* N/A. *b.* N/A. *c.* Input voltage to rectifier CR3 is 18 volts ac minimum. *d.* Output voltages of rectifier CR3 is 19 volts dc minimum.
2	Same as 1 above except adjust CN-16B/U for 127-volt ac output.	Same as 1 above.	Same as 1 above.	*a.* Input voltage to rectifer is 27 volts ac maximum. *b.* Output voltage of rectifier CR3 is 18 volts dc maximum.

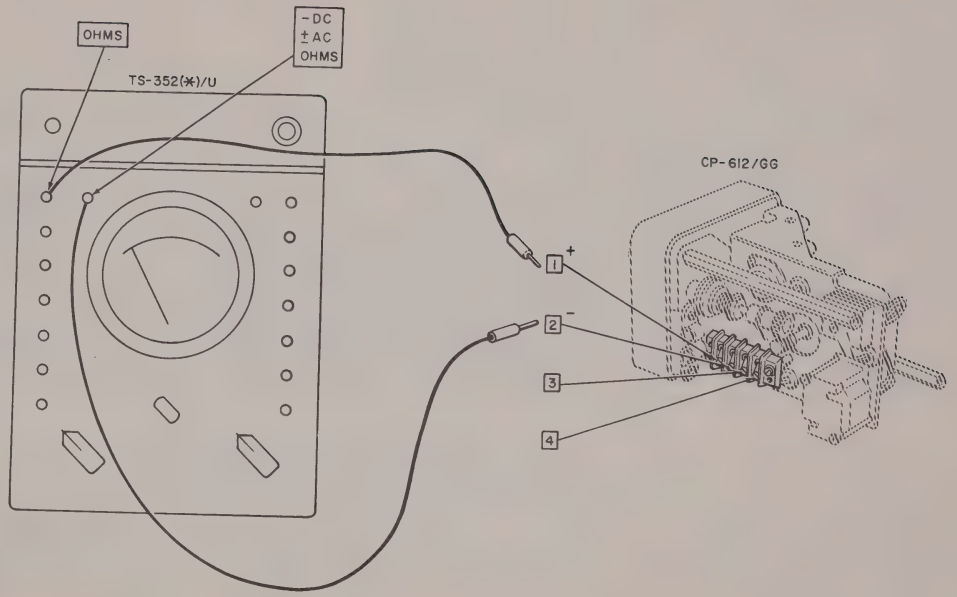


Figure 27. Input resistance test setup.

61. Input Resistance Test

a. Test Equipment. Multimeter TS-352(*)/U.

b. Test Connections and Conditions.

(1) Set the CP-612/GG power switch to OFF.
(2) Connect the TS-352(*)/U test leads as indicated on figure 27.
(3) Set the FUNCTION switch on ths TS-352(*)/U to OHMS.
(4) Set the RANGE SWITCH on the TS-352(*)/U to RX1.

Note: Short the test leads and adjust the OHMS ZERO ADJ control to zero the TS-352(*)/U before making any resistance measurements.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedures	Performance standards
1	N/A.	Power switch OFF.	Connect TS-352(*)/U red lead to terminal 1 and black lead to terminal 2 of terminal board TB1.	Meter reads 20 ohms ±5.
2	N/A.	Same as 1 above.	Reverse ohmmeter leads, black lead to terminal 1 and red lead to terminal 2 of terminal board TB1.	Meter reads 45 ohms ±10.

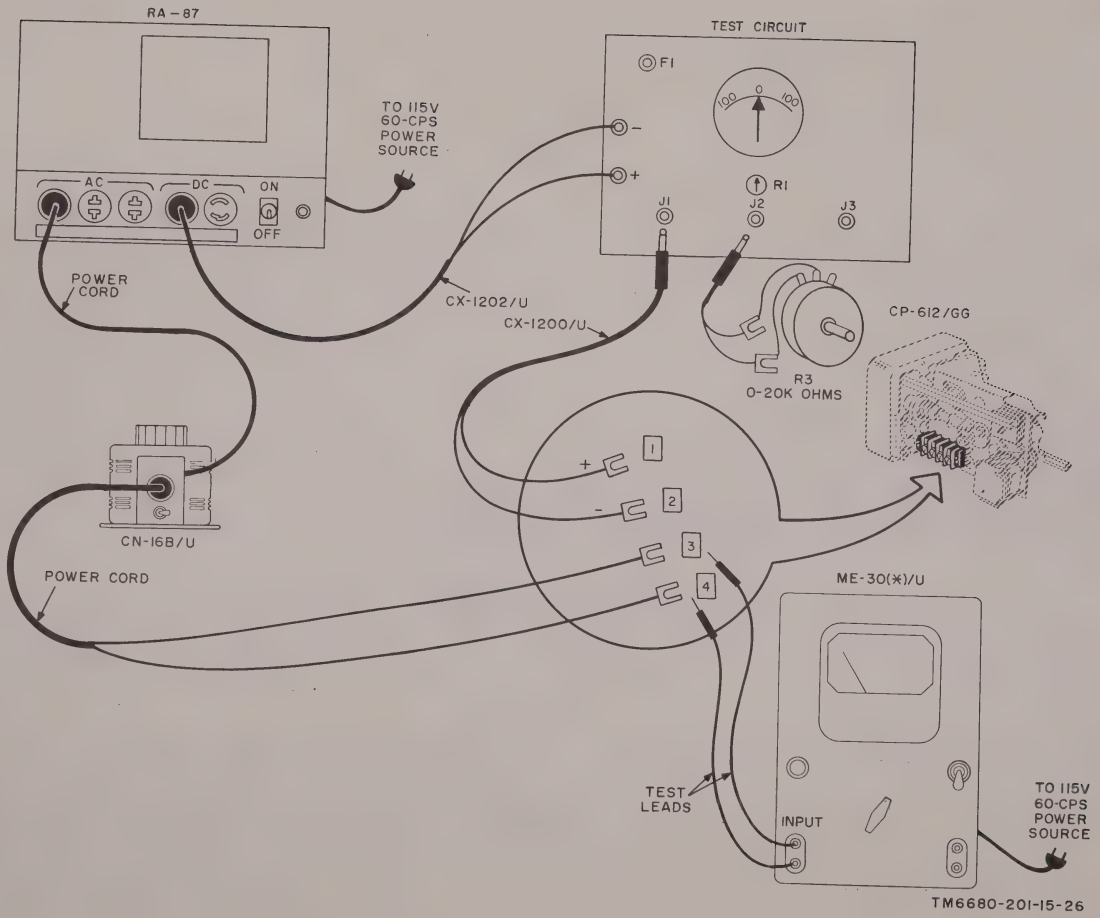


Figure 28. Operational test setup.

62. Operational Test

a. Test Equipment and Materials.

(1) Rectifier RA-87.
(2) Variable Power Transformer CN-16B/U.
(3) Voltmeter, Meter ME-30(*)/U.
(4) Test circuit constructed as given in paragraph 57.
(5) Cable Assembly CX-1200/U and Power Cable Assembly CX-1202/U.

b. Test Connections and Conditions.

(1) *RA-87.* Place the ON-OFF switch in the OFF position.
(2) *CN-16B/U.* Set to minimum output (counterclockwise); set the Power switch to ON.
(3) *ME-30(*)/U.* Set the range selector switch to 300 VOLTS: place power switch to ON.
(4) *Test Circuit.* Set the 0-5,000 ohm variable resistor (R1) and the 0-20K ohm variable resistor (R3) for maximum resistance.
(5) *Connections.* Interconnect the equipment as shown in figure 28.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedures	Performance standards
1	*RA-87:* ON-OFF switch: ON. *CN-168B/U* Adjust for 105 volts output indication on ME-30(*)/U. *Test circuit:* Variable resistor R1 set for minimum current reading.	Power switch ON.	a. Slowly vary (decrease resistance) test circuit variable resistor R4 from minimum current reading. b. Slowly vary (increase resistance) test circuit variable resistor R3 towards minimum current.	a. Stop lever actuates prior to 16-ma reading. b. Stop lever drops out (release) prior to 5-ma reading.
2	Same as above except adjust CN-16B/U for 117-volt output indication on ME-30(*)/U.	Same as 1 above.	a. Manually move the armature toward the magnet coils and look down on upper stop arm of stop lever. b. Release armature.	a. Upper stop arm is slightly out of alignment with slot in driver plate. b. Driver plate rotates one-sixth turn before stop arm engages next slot.
3	Same as 2 above.	Allow 10-minute warm-up period. Position driver plate with drive pin at top; hold stop lever so that both stop arms are free of driver plate.	Engage the hook end of the 8-ounce spring scale with the drive pin and pull horizontally until spring scale prevents the driver plate from turning.	Spring scale should read 4 to 4-1/2 ounces.
4	Same as 2 above.		a. Vary (decrease resistance) test circuit variable resistor R3 until the armature moves toward the magnet coils and the stop lever is actuated. b. Insert 0.003-inch gage between armature and pole face of magnet coil.	a. Lower arm bottoms firmly in slot of the driver plate. b. Lower arm of stop lever does not reach bottom of driver plate slot.

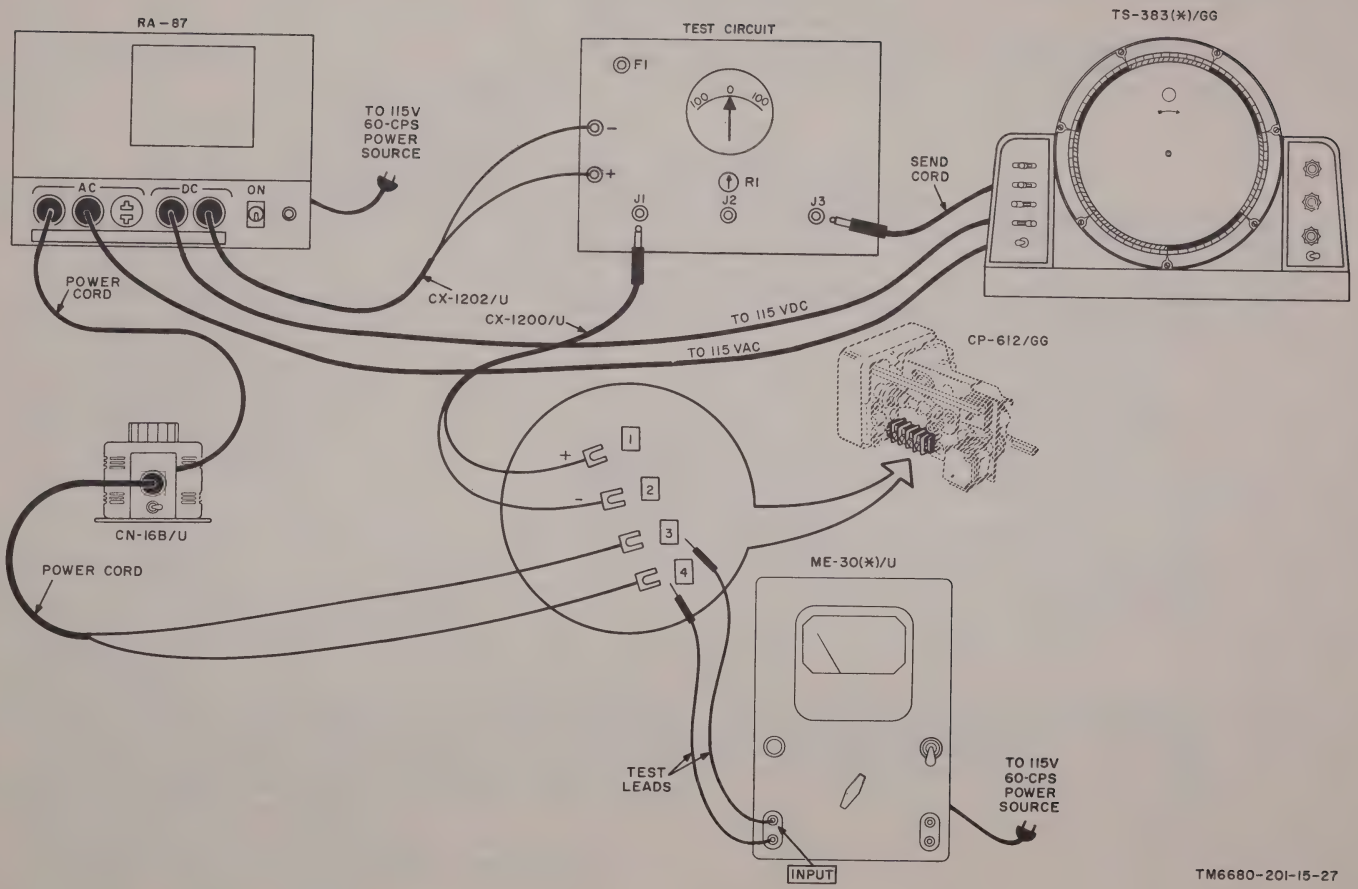


Figure 29. Bias and end distortion test setup.

63. Bias and End Distortion Test

	VIEW-TRANSMIT switch: TRANSMIT RUN-STOP switch: RUN			
3	Same as step 2 above except, *TS-383(*)/GG:* MARK-ZERO-SPACE switch: SPACE	Same as step 2 above.	Same as step 2 above.	Same as step 2 above.
4	Sames as step 3 above except, *TS-383(*)/GG:* BIAS-END DIST switch: END DIST.	Same as step 1 above.	Same as step 2 above.	Same as step 2 above.
5	Same as step 4 above except, *TS-383(*)/GG:* MARK-ZERO-SPACE switch: MARK	Same as step 1 above.	Same as step 2 above.	Same as step 2 above.

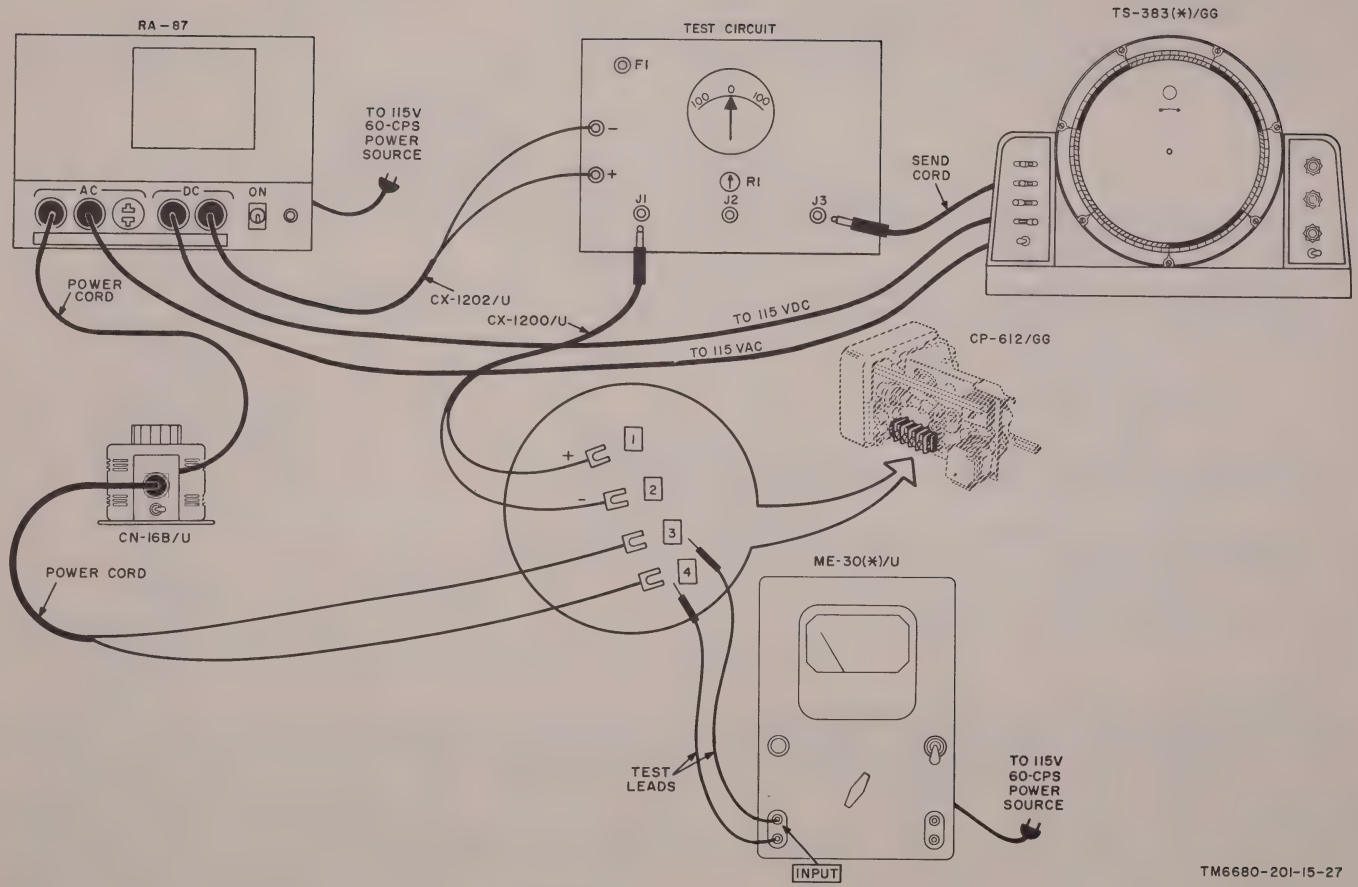


Figure 29. Bias and end distortion test setup.

63. Bias and End Distortion Test

a. *Test Equipment and Materials.*
(1) Rectifier RA-87.
(2) Variable Power Transformer CN-16B/U.
(3) Distortion Test Set TS-383(*)/GG.
(4) Test circuit constructed as given in paragraph 57.
(5) Voltmeter, Meter ME-30(*)/U.
(6) Stopwatch or electrical timer (or equal).
(7) Cable Assembly CX-1200/U and Power Cable Assembly CX-1202/U.

b. *Test Connections and Conditions.*
(1) *RA-87.* Place the ON-OFF switch in the OFF position.
(2) *CN-16B/U.* Set to minimum output (counterclockwise); set power switch to ON.
(3) *TS-383(*)/GG.* Set the switches on ths TS-383/GG as follows:
(a) RUN-STOP switch: STOP.
(b) LINE-DIST switch: DIST.
(c) BIAS-END DIST switch: BIAS.
(d) VIEW-TRANSMIT switch: VIEW.
(e) MARK-ZERO-SPACE switch: MARK.
(f) Code Selecting switch: R or Y.
(g) STOP PULSE switch: ON.
(h) MOTOR switch: ON.
(i) INCREASE DISTORTION control: Any position.
(4) *ME-30(*)/U.* Set the range selector switch to 300 VOLTS; place power switch to ON.
(5) *CP-612/GG.* See that the 100-wpm (blue) speed gear is installed in the word counter; set the power switch to OFF.
(6) *Test Circuit.* Set the 0-5,000-ohm variable resistor (R1) for maximum resistance.
(7) *Connections.* Interconnect the equipment as shown in figure 29. .

c. *Procedure.*

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standards
1	*RA-87:* Power switch: ON *CN-16B/U:* Adjust for 117-volt output indication on ME-30(*)/U. *Test circuit:* Adjust variable resistor R1 to obtain 20 ma.	Power switch: ON	Observe word counter.	Motor operates.
2	Same as step 1 above except, *TS-383(*)/GG:* INCREASE DISTORTION control: Adjust to obtain 40% distortion. Orient distortion measuring scale. LINE-DIST switch: LINE VIEW-TRANSMIT switch: TRANSMIT RUN-STOP switch: RUN	Same as step 1 above.	Permit TS-383(*)/GG to send continuous R- or Y-signals for 5 minutes as measured by stopwatch or electrical timer.	The word counter provides a count of 500 plus or minus one-half count.
3	Same as step 2 above except, *TS-383(*)/GG:* MARK-ZERO-SPACE switch: SPACE	Same as step 2 above.	Same as step 2 above.	Same as step 2 above.
4	Sames as step 3 above except, *TS-383(*)/GG:* BIAS-END DIST switch: END DIST.	Same as step 1 above.	Same as step 2 above.	Same as step 2 above.
5	Same as step 4 above except, *TS-383(*)/GG:* MARK-ZERO-SPACE switch: MARK	Same as step 1 above.	Same as step 2 above.	Same as step 2 above.

64. Test Data Summary

Personnel may find it convenient to arrange a checklist in a manner similar to that shown below:

Counter, Electrical CP-612/GG

Test	Performance standard	Test data
1. INSULATION RESISTANCE TEST Between the word counter chassis and each terminal of input terminal board TB1.	Not less than 100 megohms.	____
2. RECTIFIER VOLTAGE TEST Rectifier CR3 input voltage at 105 volts ac from power source.	Not less than 18 volts ac.	____
Rectifier CR3 output voltage at 105 volts ac from power source.	Not less than 19 volts dc.	____
Rectifier CR3 input voltage at 127 volts ac from power source.	Not more than 27 volts ac.	____
Rectifier CR3 output voltage at 127 volts ac from power source.	Not more than 33 volts dc.	____
3. INPUT RESISTANCE TEST Between terminals 1 and 2 of input terminal board TB1.		
Proper polarity at terminals of TB1.	45 ohms ±10.	____
Reverse polarity at terminals of TB1.	20 ohms ±5.	____
4. OPERATIONAL TEST Current required to energize magnet coils and stop lever.	Not more than 16 ma nor less than 5 ma.	____
Pull required to prevent the driver plate from turning.	4 to 4-1/2 ounces.	____
5. BIAS AND END DISTORTION TOLERANCE TEST Marking and spacing bias and end distortion.	Not less than 40-percent tolerance.	____

Section II. FIFTH ECHELON MAINTENANCE AND TESTING PROCEDURES

65. Fifth Echelon Maintenance

Fifth echelon maintenance includes all lower echelon maintenance procedures plus repair and part fabrication operations made possible by the availability of metal working tools and equipment such as lathes and welding equipment.

66. Purpose of Fifth Echelon Testing (Final Testing)

Word counters repaired at fifth echelon shops must meet the performance standards of new equipment. The testing procedures are identical to those performed at fourth echelon shops. Follow the procedures given in paragraphs 55 through 63 to final test a repaired word counter. The repaired equipment should meet the performance standards given in paragraph 64.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

67. Disassembly of Equipment

When required, disassemble the word counter from the MT-2684/GG as follows:

a. Disconnect the power cord from the power source.

b. Disconnect the line cord from the signal line.

c. Remove the upper right and lower left front plate machine screws and remove the front plate and housing and the word counter from the MT-2684/GG.

d. Reinstall the front plate and housing with the two machine screws.

68. Repackaging of Word Counter for Shipment or Limited Storage

The exact procedure for repackaging depends on the materials available and the conditions under which the equipment is to be shipped or stored. Adapt the following procedures whenever possible and refer to information concerning original packing (para 7) for suggestions:

a. Material Requirements. The following materials are required for packaging the word counter. For stock numbers of materials, consult SB 38-100.

Material	Quantity
Waterproof paper	2 sq ft
Waterproof tape	2 ft
Corrugated cardboard	2 sq ft
Filler material	1/2 lb
Adhesive tape	1/2 ft

b. Packaging. Wind the power and line cords around the word counter and secure the free ends to the counter rear cover with adhesive tape. Cut the corrugated cardboard approximately 6-5/8 inches wide by 18 inches long with an additional 4- by 4-1/2-inch flap at each side to be folded up over the front and rear ends of the word counter. Wrap the word counter in the corrugated cardboard and secure the wrapper with gummed tape. Wrap in waterproof paper and seal with waterproof tape.

c. Packing. Place the wrapped word counter in a cardboard container of sufficient size to permit the inclusion of approximately 1 inch of filler material on all sides of the counter. Seal the carton with waterproof tape.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

69. Authority for Demolition

Demolition of the equipment will be accomplished only upon the order of the commander. The destruction procedures outlined in paragraph 70 will be used to prevent further use of the equipment.

70. Methods of Destruction

Use any or all of the following methods to destroy the equipment:

a. Smash. Smash the word counter with a sledge, hammer, ax, handax, pickax, or crowbar.

b. Cut. Cut power cord and line cord with an ax, cutting pliers, bayonet, or machete.

c. Burn. Burn all cords, technical manuals, and word counter components; use gasoline, kerosene, oil, flamethrowers, or incendiary grenades.

d. Dispose. Bury or scatter the destroyed parts in slit trenches, foxholes, underbrush, or throw them into streams.

APPENDIX I

REFERENCES

The following applicable publications are available to maintenance personnel:

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
SB 38-100	Preservation, Packaging, and Packing Materials, Supplies and Equipment Used by the Army.
TA 11-17	Signal Field Maintenance Shops.
TA 11-100(11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops, Continental United States.
TM 11-690	Basic Theory and Application of Transistors.
TM 11-957	Rectifier RA-87.
TM 11-2050	Test Set I-48-B and Ohmmeter ZM-21A/U.
TM 11-2208	Test Sets TS-2/TG, TS-2A/TG, TS-2B/TG and TS-2C/TG (Teletypewriter Signal Distortion).
TM 11-2217	Distortion Test Sets TS-383/GG, TS-383A/GG, and TS-383B/GG.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5815-206-12	Operation and Organizational Maintenance: Teletypewriter Set AN/PGC-1 and Teletypewriters TT-4A/TG and TT-4B/TG.
TM 11-5950-205-15P	Maintenance Repair Parts and Special Tools List and Maintenance Allocation Chart for Variable Power Transformer CN-16B/U.
TM 11-6625-320-12	Operator's and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.

APPENDIX II

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

a. This appendix assigns maintenance functions to be performed on components, assemblies, and subassemblies by the lowest appropriate maintenance echelon.

b. Columns in the maintenance allocation chart are as follows:

(1) *Part or componet.* This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the component. Components, assemblies, and subassemblies are listed in top-down order. That is, the assemblies which are part of a component are listed immediately below that component, and the subassemblies which are part of an assembly are listed immediately below that assembly. Each generation breakdown (components, assemblies, or subassemblies) is listed in disassembly order or alphabetical order.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelons.

(a) Service. To clean, to preserve, and to replenish lubricants.

(b) Adjust. To regulate periodically to prevent malfunction.

(c) Inspect. To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.

(d) Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.

(e) Replace. To substitute serviceable components, assemblies, or subassemblies, for unserviceable components, assemblies, or subassemblies.

(f) Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

(g) Align. To adjust two or more components of an electrical system so that their functions are properly synchronized.

(h) Calibrate. To determine, check, or rectify the graduation of an instrument, weapon, or weapons system, or components of a weapons system.

(i) Overhaul. To restore an item to completely serviceable condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.

(j) Rebuild. To restore an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all

parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and/or specifications and subsequent reassembly of the item.

(3) *1st, 2d, 3d, 4th, 5th echelon.* The symbol X indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Entries in this column will be utilized when necessary to clarify any of the data cited in the preceding columns.

c. Columns in the allocation of tools for maintenance functions are as follows.

(1) *Tools required for maintenance functions.* This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) *1st, 2d, 3d, 4th, 5th echelon.* The dagger (†) symbol indicates the echelons normally allocated the facility.

(3) *Tool code.* This column lists the tool code assigned.

2. Maintenance by Using Organizations

When this equipment is used by signal services organizations organic to the theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

Section II. MAINTENANCE ALLOCATION CHART

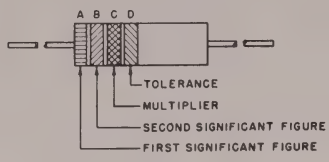
(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH	(4) 2ND ECH	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH	(8) TOOLS REQUIRED	(9) REMARKS
COUNTER, ELECTRICAL CP-612/GG								
	service	X						External Parts
				X				Interior Parts
	adjust			X			2,3,4	All Adjustments
	inspect	X						External Parts
				X				Interior Parts
	test			X			2,3,4	Performs Resistance, Voltage and Current Measurements.
					X		1,2,4,5	Conducts all tests to insure equipment returned to user meets minimum Mechanical, Visual, Electrical and Operational requirements.
	repair			X			4	
	rebuild					X	4	
	overhaul				X		4	

Section III. ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTION

(1) TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	(2) 1ST ECH	(3) 2ND ECH	(4) 3RD ECH	(5) 4TH ECH	(6) 5TH ECH	(7) TOOL CODE	(8) REMARKS
CP-612/GG (continued)							
DISTORTION TEST SET TS-383/GG				+	+	1	
MULTIMETER TS-352/U			+	+	+	2	
TEST SET TS-2/TG			+			3	
TOOL EQUIPMENT TE-50B			+	+	+	4	
VOLTMETER ME-30/U				+	+	5	
When this Equipment is used for Fixed Plant, use 3d echelon column for 2d -Fixed Requirements.							

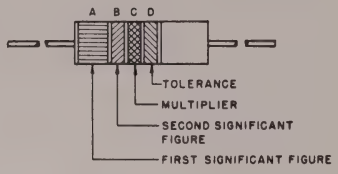
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

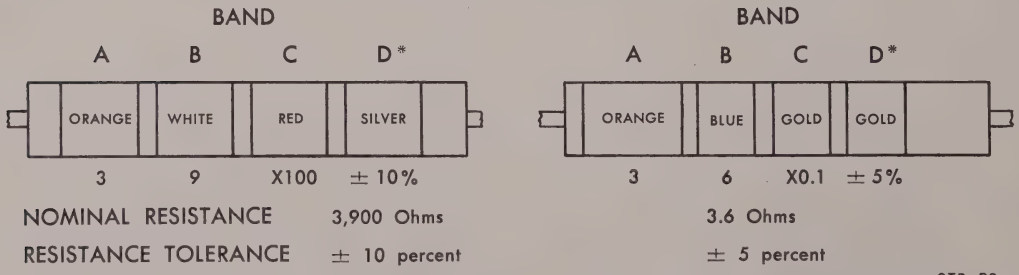


BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING



*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

Figure 30. MIL-STD resistor color code markings.

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USAAVNBD (1)
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Instl (2)
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USATC Inf (2)
USAOMC (3)
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Br Svc Sch (2)
GENDEP (2) except
  Atlanta GENDEP (none)
Sig Sec, GENDEP (5)
Sig Dep (12)
WRAMC (1)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
USAEPG (2)
AFIP (1)
AMS (1)
Army Pictorial Cen (2)
EMC (1)
Yuma Test Sta (2)
USACA (3)
USASSA (20)
USASSAMRO (1)
USASEA (1)
USA Caribbean Sig Agcy (1)
USA Sig Msl Spt Agcy (13)
Sig Fld Maint Shops (3)
USA Corps (3)
JBUSMC (2)
AFSSC (1)
Units org under fol TOE:
  (2 copies each UNOINDC)
  11–7
  11–16
  11–57
  11–97
  11–117
  11–155
  11–157
  11–500 (AA-AE) (4)
  11–557
  11–587
  11–592
  11–507

NG: State AG (3).
USAR: None.
For explanation of abbreviations used, see AR 320–50.